THE MONTHLY

Review

FEBRUARY · · · 1947

DO YOU USE ANODIC OR CATHODIC CURRENT When You Electroclean DIE-CASTINGS

WHETHER YOU USE ONE OR THE OTHER SATISFACTORY RESULTS ARE ASSURED WITH THE USE OF THE PROPER CLEPO COMPOUNDS.

A controversy has existed for some years relative to whether blistering of electroplate could be caused by cathodic or anodic current cleaning. The Clepo Laboratories have conducted exhaustive tests along these lines, and from this data have developed two new and effective Clepo Electrocleaners. Either can be used prior to copper — nickel — chromium plating and no blisters will develop if Electroplated parts are baked.

Clepo 51-H is designed for use with cathodic (direct) current; 4 to 6 volts potential and a concentration of from 4 to 6 ounces per gallon, and a temperature of 170 degrees to 190 degrees Fahrenheit. The cleaning time will be from 10 to 60 seconds — the exact time being determined by the amount of soil to be removed.

Clepo 50-K is compounded for cleaning with Anodic (reverse) current; 5 to 6 volts potential in a concentration of 4 to 6 ounces per gallon and a temperature of 170 degrees to 190 degrees Fahrenheit.

For complete information on preparation of Die-Castings prior to Electroplating, write on your firm letterhead for new Clepo Circular ZB-1.

CLEANING COMPOUNDS

FREDERICK GUMM Chemical Company Inc.

536 FOREST STREET, KEARNY, N.J.

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TO BEAT THE GLUE SHORTAGE

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NO NEED to worry about the glue shortage any longer. Without cost, you can discover for yourself a new, more efficient way to keep polishing production going. Send today for a generous free sample of GRIPMASTER . . . the amazing, *patented* polishing wheel cement that boosts polishers' output an average of 47% more pieces per head! GRIPMASTER'S secret high-heat resisting ingredient ends glazing problems... gives astounding results on *all metals* . . . ferrous and non-ferrous . . . and *plastics*. Don't delay. Take advantage of this timely free offer now!

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POLISHING, BUFFING, COLORING, and DEBURRING COMPOSITIONS.
you can rest assured that it carries a two-fold guarantee of extra quality . . . laboratory control of raw materials—combined in proper percentages and tested under actual working conditions to assure the best obtainable results in your finishing operations.
There is a Stevens Composition especially developed for use on all types of mechanical or hand buffing operations—"precision" materials, exactly uniform in formula, texture and quality. For better all-around results, use a composition bearing the Stevens trademark.
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THE MONTHLY

Review

VOLUME 34 • FEBRUARY 1947 • NUMBER 2

Published Monthly at
5800 N. MERVINE STREET
PHILADELPHIA 41, PA.
AMERICAN ELECTROPLATERS' SOCIETY
EXECUTIVE OFFICE
P. O. Box 168
JENKINTOWN, PA.
Phone: Ogontz 4663

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CONTENTS

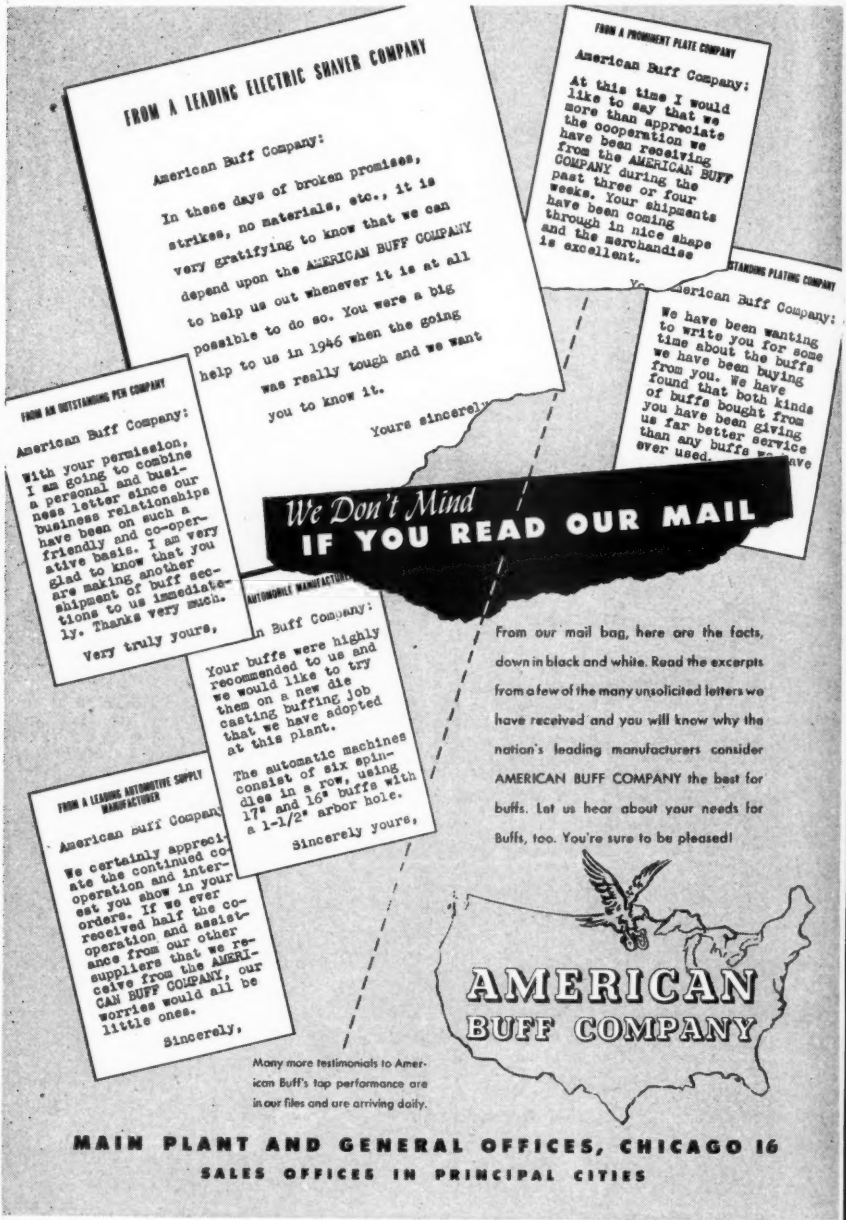
Convention News..... 135
Metal Finishing Courses..... 137
GUTHRIE, W. L. and CLIFTON, F. L., Deposition of Chromium from Chromic Acid Solutions..... 140
O'CONNOR, RAYMOND J., Sound Cost Control Procedures in the Job Plating Business..... 155
EWING, D. T. and GORDON, WM. D., A. E. S. Research Project No. 5, Effect of Impurities and Purification of Electroplating Solutions I..... 180
Research Committee Meeting..... 203
Sustaining Members..... 204

DEPARTMENTS

Book Reviews..... 171
Branch News..... 209
Abstract Section..... 173
Patents..... 218
Membership Report..... 222
Industry News..... 227
A. E. S. Branch and Officers Directory... 238
Advertisers' Index..... 241

Subscription $3.00 a year
50 cents per Copy

Entered as second class matter July 1, 1946, at the post office at Philadelphia, Pa., under Act of August 24, 1912.


FROM A LEADING ELECTRIC SHAVER COMPANY
American Buff Company:
In these days of broken promises, strikes, no materials, etc., it is very gratifying to know that we can depend upon the AMERICAN BUFF COMPANY to help us out whenever it is at all possible to do so. You were a big help to us in 1946 when the going was really tough and we want you to know it.
Yours sincerely
FROM A PROMINENT PLATE COMPANY
American Buff Company:
At this time I would like to say that we more than appreciate the cooperation we have been receiving from the AMERICAN BUFF COMPANY during the past three or four weeks. Your shipments have been coming through in nice shape and the merchandise is excellent.
FROM AN OUTSTANDING PEN COMPANY
American Buff Company:
With your permission, I am going to combine a personal and business letter since our business relationships have been on such a friendly and co-operative basis. I am very glad to know that you are making another shipment of buff sections to us immediately. Thanks very much.
Very truly yours,
STANDING PLATING COMPANY
erican Buff Company:
We have been wanting to write you for some time about the buffs we have been buying from you. We have found that both kinds of buffs bought from you have been giving us far better service than any buffs ve over used.
We Don't Mind
IF YOU READ OUR MAIL
AUTOMOBILE MANUFACTURER
n Buff Company:
Your buffs were highly recommended to us and we would like to try them on a new die casting buffing job that we have adopted at this plant.
The automatic machines consist of six spindles in a row, using 17" and 16" buffs with a 1-1/2" arbor hole.
Sincerely yours,
FROM A LEADING AUTOMOTIVE SUPPLY MANUFACTURER
American Buff Company:
We certainly appreciate the continued cooperation and interest you show in your orders. If we ever received half the cooperation and assistance from our other suppliers that we receive from the AMERICAN BUFF COMPANY, our worries would all be little ones.
Sincerely,
From our mail bag, here are the facts, down in black and white. Read the excerpts from a few of the many unsolicited letters we have received and you will know why the nation's leading manufacturers consider AMERICAN BUFF COMPANY the best for buffs. Let us hear about your needs for Buffs, too. You're sure to be pleased!
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Many more testimonials to American Buff's top performance are in our files and are arriving daily.
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A new sixteen-page, three-color booklet about Harshaw Modified XXX Bright Nickel Process has been sent to our mailing list. Watch for your copy of this well illustrated, informative booklet. If by chance you do not receive it, then write, and we'll gladly send one to you.

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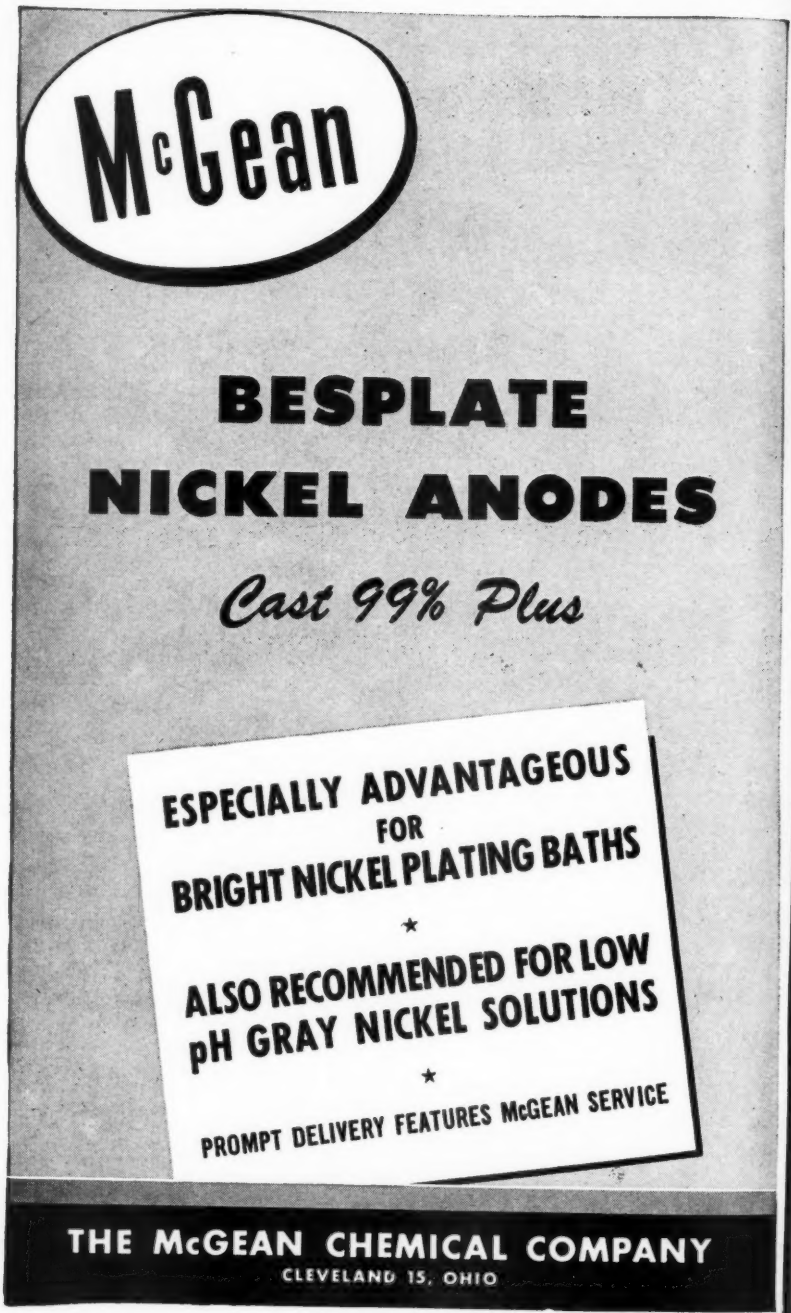
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ESPECIALLY ADVANTAGEOUS
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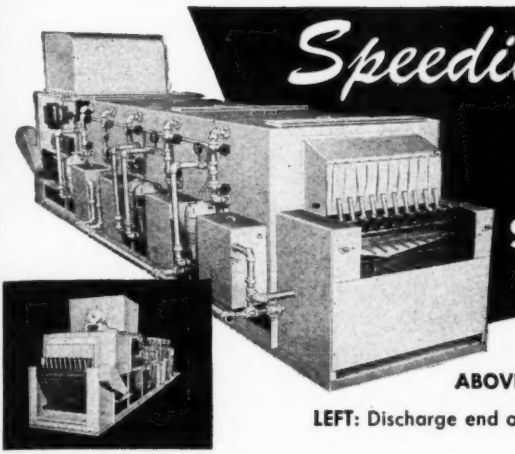

Speedier CLEANING in 7 simple stages

ABOVE: Loading end of Machine

LEFT: Discharge end of Machine

The cleaning of cylindrical brass cases following polishing and directly prior to plating, was a problem in a large metal parts manufacturing plant. The OPTIMUS Flat Conveyor Type Washing Machine shown above, now handles this operation in seven simple consecutive stages: Hot Alkali Wash, Drain, Hot Water Rinse, Warm Sodium Cyanide Wash, Cold Rinse to Sewer, Hot Rinse, Dry.

The entire operation takes the parts directly from polishing and feeds direct to the plating machine, the entire cleaning operation being timed to fit in with these other steps. The two hot rinses are hooked in sequence, thus effecting a further operating saving. Conveyor can also be built with flight bars for baskets and individual pieces, or with a mesh belt for any type of parts in bulk or individual pieces.

- *The* **RIGHT** *Machine*
- *The* **PROPER** *Detergent*
- *The* **CORRECT** *Cleaning Method*

OPTIMUS *Provides Them All*

An OPTIMUS Plan for the mechanized handling of your metal parts through washing, degreasing, rinsing and drying, can assist you in saving labor, materials and speeding up production. Submit your problems to the OPTIMUS engineering staff.

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STANDARD AND SPECIAL TYPES OF EQUIPMENT FROM THE SMALLEST TO THE LARGEST SIZES FOR A WIDE VARIETY OF OPERATIONS.

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Cowles FAST ACTING EMULSION SOLVENT CLEANER

LIXOL works fast and is a dependable emulsion cleaner for still tank, pre-soak or washing machine equipment. It can be used straight or diluted with water or kerosene.

- LIXOL penetrates
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- LIXOL prevents rust

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How Long Should a Rack Coating Last?

UNICHROME RACK COATING 202

may change your ideas

Some rack coatings start to fail after a few cycles. Some stand up and give good service—until they come up against really tough plating conditions. But platers who use Unichrome Rack Coating 202 tell us they consistently get longer service—under any conditions. For instance:

In the anodizing tank of an automobile manufacturer, Unichrome Rack Coating 202 actually outlived the rack—in 5000 cycles, the contacts wore out before the coating! One metal finisher uses 202 on racks in an electropolishing bath—reports it "the best found for this application." For chromium plating, another says 202 is "far superior to any other rack coating tried."

Try this long-lasting coating in your own plant. You'll cut your expenses by stretching the time between recoating jobs. Unichrome Coating 202 is applied by dipping, and then is force dried into a tough, flexible, adherent non-contaminating coating that resists plating baths, cleaning solutions, shop handling. We'll be glad to test-coat one of your racks without charge. Write your nearest Unichrome office for details.

For Air Drying—
UNICHROME RACK COATING 203

This convenient, air-drying coating has excellent adherence for all plating cycles such as chromium, nickel, copper, zinc and cadmium.

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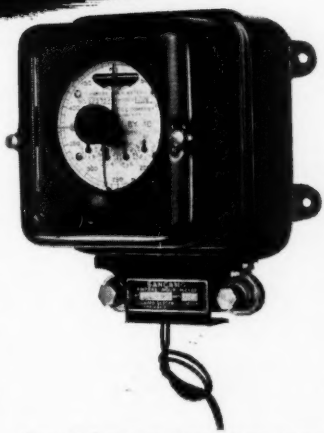
✓ EFFICIENT SOLUTIONS
✓ UNIFORM PRODUCTION
✓ BALANCED STOCKS

with SANGAMO AMPEREHOUR METERS

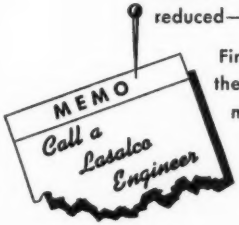
Hit-and-miss methods have no place in modern plating departments where quality production demands positive control for a smooth, regular flow of work.

Sangamo Amperehour Meters give the accurate record required for control of the plating bath—provide a method for determining uniform thickness of deposit—permit average shop men to maintain the most critical solutions, regular or bright, acid or alkaline.

By registering the number of amperes used in terms of amperehours, Sangamo Amperehour Meters make proper balancing of solution easy and sure. Cost figuring is simplified—underplated or overplated rejects are eliminated—current consumption is reduced—less manpower is used.



Type IT Sangamo Amperehour Meter for indicating amperehours used in single operations, as well as totalizing long period plating.



Find out why hundreds of the busiest plating departments consider Sangamo Amperehour Meters a self-paying investment. Write for complete information today.

NOTE

There are three types of Sangamo Amperehour Meters—Type I for indicating amperehours used in single plating operations; Type T for totalizing amperehours used in all plating operations; Type IT combining all features to indicate individual operations and to totalize long runs. When ordering, specify maximum amperage used at any one time.

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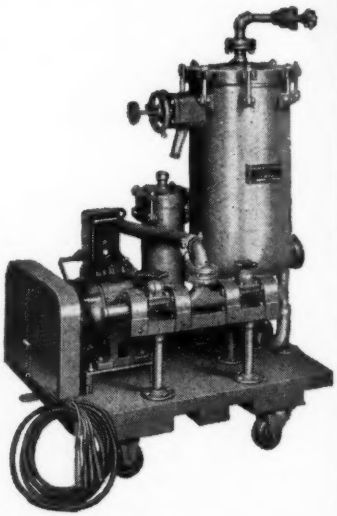
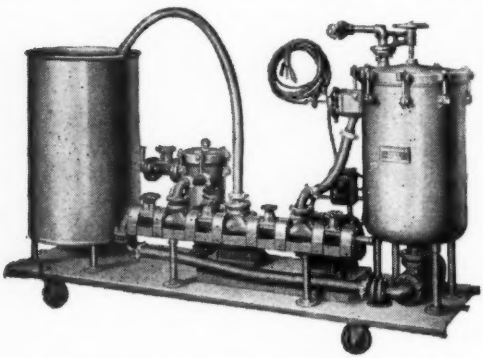
INSTALL MODERN INDUSTRIAL FILTERS IN YOUR PLATING PLANT

You can keep your plating plant operating at top efficiency only if you have adequate filtration. Industrial filter systems are designed and built to provide continuous high speed filtration and circulation.

Industrial Filters equipped with the AIRWASH cleaning feature have been in continuous use for months without opening the filters or removing the plates. Air agitation quickly dislodges the accumulated sludge and leaves the filter clean and ready for a new filter cycle. Many hours of production time are saved thus lowering your operating costs.



No. 2—A typical portable filter as constructed for bright nickel, acid copper and other acid type bath. Used for either intermittent or continuous filtration.



No. 1—Filter shown is equipped with slurry tank with double suction and discharge control providing an ideal continuous filtration system.

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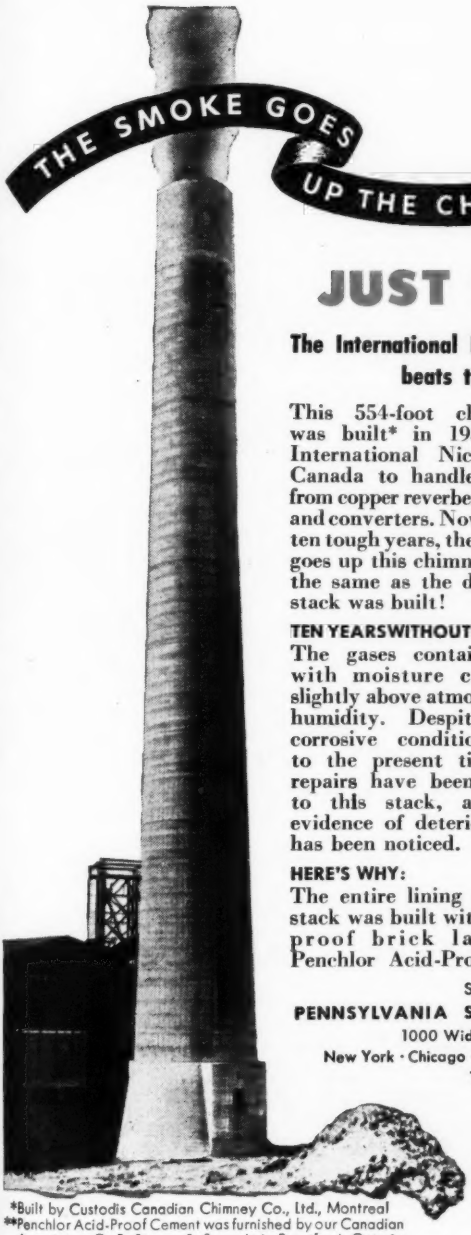

JUST THE SAME!

The International Nickel Company of Canada, Limited beats tough corrosion condition

This 554-foot chimney was built* in 1936 for International Nickel of Canada to handle gases from copper reverberatories and converters. Now, after ten tough years, the smoke goes up this chimney just the same as the day the stack was built!

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The gases contain SO_2 with moisture content slightly above atmospheric humidity. Despite this corrosive condition, up to the present time no repairs have been made to this stack, and no evidence of deterioration has been noticed.

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The entire lining of this stack was built with acid-proof brick laid in Penchlor Acid-Proof Cement.** In addition, the top fifty feet of this stack was further protected by using Penchlor Acid-Proof Cement for pointing the outside surface joints. Penchlor Acid-Proof Cement is a superior sodium silicate cement that is quick-setting and self-hardening. Its outstanding record of satisfactory service has been proved in chemical plants, steel mills, paper and pulp mills, oil refineries and smelting plants.

SEND FOR CASE REPORT

If you have a corrosion problem, you'll be interested in further details about this Penchlor installation, as well as an illustrated brochure on Penchlor. Write for Case Report Number 66-2.

Special Chemicals Division

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**Penchlor Acid-Proof Cement was furnished by our Canadian Associates, G. F. Sterne & Sons, Ltd., Brantford, Ontario

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This superior buffing bar is noted for being extremely soluble in mild alkali *because of its pre-saponified Tripoli composition* . . . tests prove that WONDERBAR eliminates manual scrubbing prior to plating, reduces labor costs, speeds production and makes expensive degreasing machines unnecessary.

Compounds formulated by THE PURITAN MANUFACTURING COMPANY guarantee a perfect finish. Because they are made with the finest ingredients, these cleaning, plating and finishing compounds are Safe and Reliable . . . insure greater profits because they last longer . . . eliminate extra operations thereby saving time and money.

THE Puritan MANUFACTURING COMPANY
WATERBURY, CONNECTICUT

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A compound that quickly and efficiently removes metallic burrs and fins that occur during processing. Applied to the wheel, it is self-lubricating to prevent friction, embrittlement and burned surfaces. *PUR-BUR assures a smooth and rapid removal without dangerous results.*

Safe on any surface

THERE'S one metal cleaner that just doesn't fall down on the job. That's Wyandotte Metal Cleaner No. 38.* This *balanced* product can solve practically all the cleaning needs of the average plant with economy and efficiency.

Wyandotte Metal Cleaner No. 38 is all-soluble. It dissolves quickly, rinses easily and completely. It is designed to correct water conditions . . . wet rapidly . . . give long life in solution. It is inhibited to prevent corrosion of the metal being treated.

Wyandotte Metal Cleaner No. 38 is being used successfully for electro-cleaning of ferrous metals, as well as copper and brass. It is a proven reverse current cleaner for zinc-base die-castings. It is giving satisfaction when used in electro-cleaning baths on hand-operated semi- and full-automatic line . . . in still-cleaning solutions . . . in tumble barrel equipment . . . in pressure spray and rotary type metal parts washing machines.

Let your Wyandotte Representative tell you more about the advantages of Wyandotte Metal Cleaner No. 38. He's always at your service.

*Temporarily in short supply.

Wyandotte
REG. U. S. PAT. OFF.

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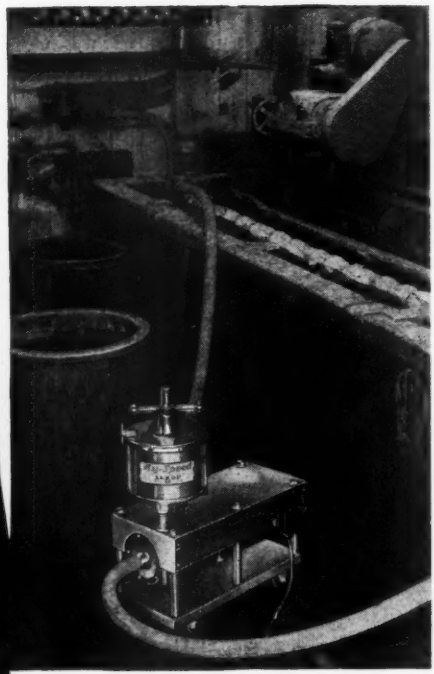
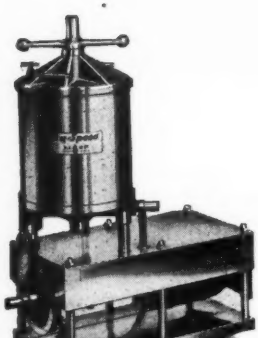
The FILTER that Plating Shop Men Are Buying... ...ON ITS REPUTATION





This Filter complete as shown, requires very little floor space, though it is capable of handling as large a volume of solution as conventional filters many times their size.

Outstanding for protection against pitting, spotting, poor adhesion, formation of nodules, etc., which mean rejects and reworking, "Sealed-Disc" Filters have won high reputation in plating rooms large and small all over the world.

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"Sealed-Disc" Filters remove all traces of dirt, dust, oil, sludge and all other impurities from plating solutions, yet will not affect brighteners. They are light, compact, portable and easy to move from one tank to another for instant use.

Write for complete information or contact your regular plating supplier.

ALSOP

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the power you want... when you want it!

to meet varying demands of plating and anodizing

G-E COPPER-OXIDE RECTIFIERS

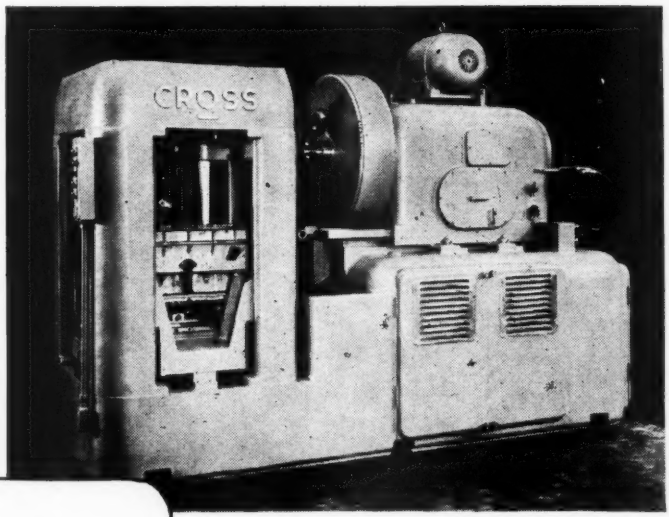
offer quick power change-over . .

There's no need to be tied down by a fixed power supply. The flexibility of General Electric copper-oxide rectifiers offers you a wide choice of current and capacity to meet the requirements of various types of plating. You can easily install one or more G-E units without special foundations or expensive accessories. Others can be added as needed. With G-E rectifying equipment, you have "building block" changeability for series, parallel, series-parallel circuit arrangements.

Basically a step-down transformer and a rectifier, each self-contained G-E unit supplies smooth, steady d-c in blocks of 6 or 12 volts. Control is manual or automatic. With the automatic control, voltage is maintained at within plus or minus one per cent from no-load to full-load. Adjustment is controlled at a-c input for economy.

There are many G-E combinations designed and engineered to meet the most exacting plating and anodizing conditions. For information and illustrated booklet, write Section A30-258, Appliance and Merchandise Dept., General Electric Company, Bridgeport 2, Connecticut.

GENERAL ELECTRIC



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Specialized finish of high quality is required to protect the surfaces of high-production automatic tools . . . and specialized finish of high quality is what Egyptian supplies, always.

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THE EGYPTIAN LACQUER MANUFACTURING COMPANY

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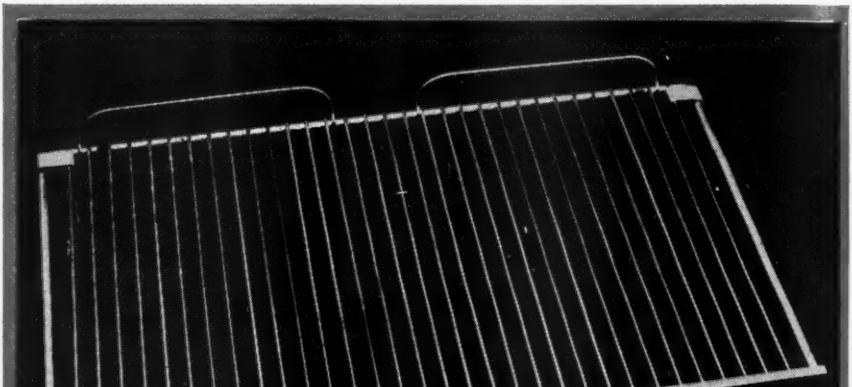
DETROIT—1947 A. E. S. CONVENTION CITY

CONVENTION NEWS

The plans for the Detroit Convention on June 23–27 are rapidly being formulated by the Convention Committee with Mr. George L. Nankervis as General Chairman.

After much discussion, the Educational Committee has reached the decision to limit the number of *papers* to twelve and to accept only such papers which are likely to promote lively discussions from the floor. In the past, the large number of papers has often made it necessary for the meeting chairman to limit very fruitful discussions because of lack of time. This will not happen in Detroit. Dr. R. B. Saltonstall, Chairman of the Educational Committee, advises that already eight papers have been accepted for presentation.

Although no publicity had been given to the *Industrial Finishing Exposition* except for the write-up in the January issue of The Monthly Review, 25% of the space in the Convention Hall had already been sold on January 11, according to Mr. H. E. Head who, with Mr. E. F. Berry, heads the Exhibits Committee. This Exposition promises to become a real mile-post in the history of electrodeposition and of A. E. S. Information may be had by addressing *Industrial Finishing Exposition*, Convention Hall, 4484 Cass Avenue, Detroit 1, Mich.



Luster-on*— Versatile, Attractive, Inexpensive and Available

Unretouched Photograph

These refrigerator shelves, manufactured by the Canadian General Electric Company, are first zinc plated. Then they're Luster-on* Dipped before being coated with water dip lacquer. And the necessary handling that ordinarily leaves smudges and stains on zinc surfaces has no effect on these shelves once they've received a simple cold-dip in Luster-on*.

In addition to giving a more uniform and attractive finish than untreated zinc, Luster-on* provides a superior adhesive surface for the final lacquering . . . protection against corrosion by making the zinc passive . . . and sparkling appearance that's sure to catch a customer's eye.

The Canadian General Electric Company is but one of many manufacturers that find Luster-on* on zinc inexpensive and easy to use in place of hard-to-get, high-priced tin or cadmium. Their approval of Luster-on* is your guarantee of its excellence. Available in two types—for manual or automatic use. Send coupon for full details.

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THE Chemical CORPORATION
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Please send me full particulars about Luster-on* bright dip for zinc surfaces. I am (am not) sending sample part for free dip. No obligation, of course.

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Metal Finishing Courses

The Executive Officers of your Society have been receiving an increasing number of inquiries about college courses in Metal Finishing from people interested in furthering their education in this subject.

The information available for answering these queries is quite meager.

It is realized that information of this nature would be invaluable to the prestige of a Society whose aim is "To improve and disseminate the art and science of Electrodeposition and all its allied arts, and to increase the knowledge of those occupied in the numerous applications of Electroplating".

The following letter is printed in its entirety in order to indicate to the members present trends. It is evident that the requirements in this field have reached such proportions that definite courses are being established which lead to a degree with a major in Metal Finishing. To the best of our knowledge, it is one of the first such courses offered by a college in this country. Let us hope that it is a forerunner of the establishment of similar courses in colleges throughout the country.

ROCHESTER INSTITUTE OF TECHNOLOGY
65 PLYMOUTH Ave. So.
ROCHESTER, N. Y.
NOVEMBER 18, 1946

DEAR MR. HUSTON:

THIS LETTER IS IN ANSWER TO YOURS OF THE 12TH INQUIRING ABOUT THE INSTITUTE'S PROGRAM IN METAL FINISHING.

THIS INSTITUTE OPERATES ON A COOPERATIVE BASIS, I. E., OUR STUDENTS SPEND A PORTION OF EACH YEAR IN SCHOOL AND THE REMAINDER IN INDUSTRY. THE PROGRAM IS VERY SUCCESSFUL: THE INDUSTRIES IN ROCHESTER AND NEARBY ACCEPT OUR STUDENTS UNDER SUCH AN ARRANGEMENT, AND VERY FREQUENTLY THE STUDENTS FIND PERMANENT EMPLOYMENT WITH THE INDUSTRY IN WHICH THEY WORKED WHILE ATTENDING SCHOOL. EACH COURSE OF STUDY OFFERED HERE IS OF THREE YEARS' DURATION.

THE METAL FINISHING PROGRAM WAS NEWLY OFFERED THIS YEAR IN ANSWER TO A GROWING DEMAND BY ROCHESTER INDUSTRY FOR MEN WITH A BACKGROUND THAT WOULD ENABLE THEM TO BE GROOMED FOR SUCH POSITIONS AS FOREMAN PLATERS, RESEARCH ASSISTANTS, ETC.

THE DETAILS OF THE COURSE HAVE NOT BEEN WORKED OUT AS YET. DURING THE FIRST YEAR, THE STUDENTS INTERESTED IN METAL FINISHING WILL TAKE THE SAME FUNDAMENTAL COURSES IN CHEMISTRY, PHYSICS AND MATHEMATICS AS THE OTHER CHEMISTRY MAJORS. IN THE SECOND AND THIRD YEAR, THEIR TRAINING WILL BEGIN TO BECOME SPECIALIZED. THE COURSES TO BE OFFERED ARE TENTATIVELY AS FOLLOWS:

LABORATORY:

1. A GENERAL COURSE IN GRINDING, POLISHING AND BUFFING, BURNISHING, CLEANING, PICKLING, ETC. THESE OPERATIONS WILL BE CONSIDERED FROM A CHEMICAL STANDPOINT RATHER THAN IN AN ATTEMPT TO TURN OUT FINISHED POLISHERS, GRINDERS, ETC., BECAUSE OUR STUDENTS ARE BEING TRAINED IN THE PRACTICE OF THESE OPERATIONS WHILE THEY ARE AT WORK IN INDUSTRY.
2. A THOROUGH COURSE IN THE PLATING OF METALS, APPLICATION OF PROTECTIVE COATINGS, ETCHING, ETC., TO ACCOMPANY THE LECTURES IN ELECTROPLATING.
3. ELECTROCHEMISTRY COURSE—TO GO WITH THE LECTURES IN ELECTROCHEMISTRY.

LECTURES:

1. GENERAL METAL FINISHING—AN OUTLINE OF THE THEORY APPLICABLE TO THE OPERATIONS WHICH THE STUDENTS WOULD STUDY IN THE LABORATORY.
2. ELECTROCHEMISTRY—AS PRESENTED IN DOLE'S BOOK ON ELECTROCHEMISTRY, INCLUDING ALSO THE STUDY OF THE THEORY OF CORROSION.
3. ELECTROPLATING — LARGELY TAKEN FROM "MODERN ELECTROPLATING", THE SPECIAL VOLUME PUBLISHED BY THE ELECTROCHEMICAL SOCIETY.

4. Strength of materials and metallurgy—a study of materials and methods, including metallurgy tailored to fit electroplating.

This program is not definitely fixed as yet, and we should be pleased to have your reaction to it as well as any constructive criticism which you, on the basis of your experience, may be prepared to offer.

The cost will be approximately $250.00 per year. Inquiries concerning the course should be addressed to Dr. R. L. Van Penrsem, Head of the Chemistry Department. My particular job here is to whip this program into shape so that it will be ready for our second and third year students next year and the year after. I have a year's grace inasmuch as our first year students are now taking only the fundamental courses offered.

At present we have in the neighborhood of thirty students registered for the metal finishing course who have been placed in cooperative jobs in the metal finishing departments of such companies in Rochester as Eastman Kodak Co., Taylor Instrument Co., Hickok Mfg. Co., Rochester Products Corp. (a subsidiary of General Motors Corporation), and others.

I shall be happy to send you any additional information that you desire.

Sincerely yours,

(*Signed*) John Landfr.

Efforts are now being made to survey other colleges to determine what courses, if any, are being offered in metal finishing and to obtain recommendations for all the subjects and laboratory work which should be included in a college course specializing in metal finishing. The results of the survey will be published in a later issue of The Review.

The Educational Chairman of the Society will appreciate any information which any member can furnish him regarding colleges or universities offering subjects, or complete courses, in metal finishing.

Ken Huston,
Educational Chairman.

Members Donate Society Publications

Files of the Society's publications, complete with few exceptions, are now available at the following institutions which are equipped to supply photostatic copies of any articles desired:

The Library of Congress, Washington, D. C.

The Free Library of Philadelphia, Logan Square, Philadelphia, Pa.

The Enoch Pratt Public Library, Baltimore, Md.

In addition, the Los Angeles Public Library has been provided with unbroken sets of The Monthly Review going back to 1929 and of the *Proceedings* back to 1938. This has been accomplished through the cooperation of Messrs. Ray Bray, Earl Coffin, Fred Herr, E. R. Holman, John Merigold, Frank Rushton, M. D. Rynkofs, Clarence Thornton, Ray Vasques and the Libraries of Crown City Plating Company, The Institute of Aeronautical Sciences, and Turco Products, Inc. The Executive Secretary's Office is supplying additional copies of the Review back to 1915 and seven prior volumes of the *Proceedings*.

Through the courtesy of Mr. Albert G. Tracy of the Grand Rapids Branch, the Grand Rapids Public Library has received the November and December, 1938 and the 1939–1944 issues of The Monthly Review. The Executive Secretary's office has furnished the 1945 and 1946 issues as well as the *Proceedings* for 1943 and 1944.

We hereby gratefully acknowledge receipt of back issues of the Society publications during the past month from the following:

Mr. W. J. Thompson, Stratford, Conn., of the Bridgeport Branch.

Mr. Austin Fletcher, Binghamton, N. Y., of the Syracuse Branch.

Turco Products, Inc., Los Angeles, Calif.

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DEPOSITION OF CHROMIUM

From Chromic Acid Solutions

A STUDY OF CHARACTERISTICS AND THE CONTROL OF SULFATE CONTENT WITH BARIUM

W. L. Guthrie and F. L. Clifton

RESEARCH LABORATORIES DIVISION, GENERAL MOTORS CORPORATION

DETROIT, MICHIGAN

INTRODUCTION

In the deposition of chromium from acid solutions, the concentration of metallic ions in the bath is not maintained by dissolution of metal anodes, but is restored to the optimum value, after depletion, with additions of chromic acid. The severe shortage of chromic acid for decorative plating during the reconversion period prompted work on the determination of the plating characteristics of chromic acid baths of subnormal concentration.

It is well known that one of the most important variables to be controlled in a chromium plating bath is the relative proportion of chromic acid to sulfate ions. If this proportion varies markedly from the optimum value, poor throwing power or poor current efficiency results. If the chromic acid concentration cannot be restored after depletion, some means must be devised for the removal of part of the sulfate in order that the proper relation of chromic acid to sulfate be maintained.

GENERAL CONSIDERATIONS

In the deposition of chromium, as of other metals, the electroplater is interested in turning out a well-plated article with the most efficient utilization of the available equipment. His primary concern is the appearance of the plated part, but he must, at the same time, keep in mind specifications as well as overall efficiency which includes items such as voltage required, current efficiency and heating cost.

However, as long as the articles come from the bath uniformly bright and completely covered, overall efficiency can be regarded as secondary. The term throwing power is used here to describe the ability of a chromium plating bath to give a uniformly bright deposit over an irregular object or, more specifically, over a wide range of current densities. In fact, some investigators have used the ratio of the highest to the lowest current density which give bright deposits as a measure of the throwing power. Although the throwing power by that method is also determined by experiment, nevertheless it is somewhat less empirical than the method used in the work to be described in this article.

Changes in conditions of plating or unbalancing of the relative proportion of electrolyte constituents first manifest themselves in a change of throwing power. This change is generally a decrease, in that most chromium plating baths are operated under conditions which give the maximum throwing power obtainable. Since the throwing power is a variable dependent upon the composition of the electrolyte and the plating conditions, it can be used as a guide in the determination of how far conditions are removed from the optimum.

According to Faraday's laws of electrolysis, the amount of any particular metal deposited from an electrolyte is dependent upon the amount of electricity passed and its chemical equivalent weight. For every faraday (96,500 coulombs) of electricity

passed, one equivalent weight of the metal will be deposited. In some cases, however, conditions during electrolysis are such that other products are formed at the cathode. The liberation of these products uses part of the electricity, leaving only part for the reduction of metallic ions. The ratio of the electricity used for metal deposition to the total amount passed is called the cathode current efficiency. It is equivalently expressed as the ratio of the actual weight of metal deposited to the theoretical weight which should have been deposited and thereby affords a convenient means for determining the efficiency of any electrolyte.

During the electrolysis of a chromic acid solution, the current is used for two processes at the cathode. They are: (1) reduction of chromium ions, and (2) reduction of hydrogen ions and evolution of hydrogen. Of the hexavalent chromium ions that are reduced, only a portion is reduced completely to metallic chromium, the remainder being only partially reduced, namely to trivalent ions. Actually, a large part (80% or more) of the current is ineffective toward producing a metallic coating. Even though the current efficiency is low, the process is still economically feasible for the deposition of thin chromium coatings such as are used in bright decorative work. Like throwing power, efficiency is markedly affected by changes in plating conditions and composition of the electrolyte, which affords another means of analyzing the characteristics of chromic acid electrolytes.

Before going further, it might be well to consider some of the independent variables concerned in the deposition of chromium. As in other plating baths, the character of the deposits is largely dependent upon the composition of the electrolyte. The electrolyte for chromium plating is relatively simple, consisting originally of only two materials: (1) chromic acid anhydride (CrO_3) and (2) small mounts of a suitable sulfate. However, the concentration of metallic ions is not maintained by dissolution of anodes as in most plating baths. The electrolyte is the sole supply of metal. The purpose of the chromic acid anhydride (more commonly called chromic acid) is, therefore twofold: (1) to furnish ions for conducting the electric current and (2) to act as a large reservoir of metal. When this reserve of metal is depleted, either by plating or by drag-out losses (in commercial plating the latter losses are by far the greater), it is replenished with additions of chromic acid.

The most commonly used material for introducing the sulfate ion into the bath is sulfuric acid, principally because it adds no harmful cations to the electrolyte. The amount of sulfate added to the bath is largely determined by the concentration of chromic acid. Rather than the absolute amount of sulfate, it is the relative amount of sulfate to chromic acid that is the important factor to be considered. Both throwing power and current efficiency are markedly affected by this fraction.

As was previously stated, not all of the chromium ions reduced at the cathode are reduced completely. Many are only reduced to trivalent ions—the proportion depending chiefly upon the cathode current density. In fact, a particular range of current density can be chosen so that the partial reduction process (hexavalent to trivalent) is the only reaction taking place at the cathode interface. This range is narrow and falls below the current density at which some of the ions are reduced completely and chromium metal is deposited. Actual values range from 10 to 50 asf, depending upon the temperature, the chromic acid concentration, etc.

Since the trivalent constituent is dark, its formation can be made visible, provided the concentration of other impurities is not too high, by making use of a transparent plating cell as shown in Fig. 1. As the solution is being electrolyzed at a low current density, the dark brown or black trivalent chromium can be seen descending from the cathode—the electrode on the left. As electrolysis is being continued, the partially reduced chromium continues to form and collects in the undisturbed portion of the electrolyte below the electrodes as shown in Fig. 2. The color of the bath changes from an orange-red to a dark brown or black as the trivalent chromium concentration in-

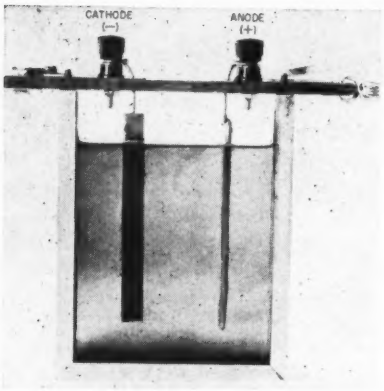


Fig. 1. Transparent plating cell. Note trivalent chromium descending toward bottom

creases. Evidence that the dark layer of solution at the bottom of the cell contains more trivalent chromium than the upper or lighter colored layer is furnished by a chemical analysis of the two strata. (Table I.)

Were it not for the fact that some of the trivalent chromium ions are reoxidized back to hexavalent ions at the insoluble anodes, their concentration would build up to such an extent that operation of the bath would have to be discontinued. Fortunately, however, the limiting value for the concentration of trivalent chromium is quite high (over 20 grams per liter) and is seldom reached when the proper anode material is used. Trivalent ions decrease both the conductivity of the electrolyte and the width of the operating range. However, for low concentrations, these effects are small.

TABLE I
ANALYSIS OF STRATIFIED CHROMIUM PLATING SOLUTION ELECTROLYZED AT LOW CURRENT DENSITY

Layer	CrO_3 g/l	Cr^{+++} g/l
Upper, light	120.4	0.53
Lower, dark	121.2	1.76

Two other factors or independent variables that determine to a large extent the character of electrodeposited chromium, are: (1) the temperature of operation and (2) the cathode current density. These two may be called the "plating conditions". Changes

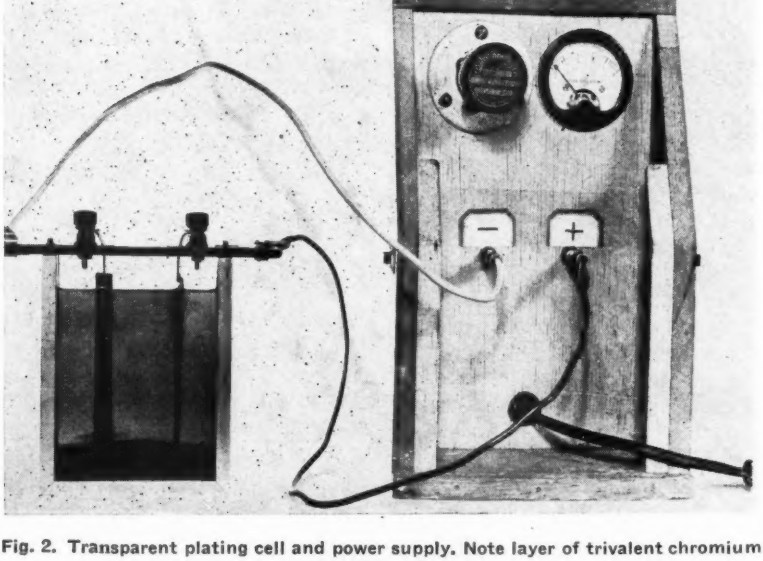


Fig. 2. Transparent plating cell and power supply. Note layer of trivalent chromium on bottom of cell

in temperature cause changes in conductivity and viscosity while the current density affects polarization. Variations of these factors are manifested in changes in efficiency and throwing power.

Altogether there are seven variables to be considered in a study of the characteristics of chromium plating solutions, five being independent variables: (1) chromic acid concentration, (2) fraction or proportion of sulfate to chromic acid, (3) trivalent chromium concentration, (4) temperature and (5) current density. The two dependent variables are: (1) current efficiency and (2) throwing power. In the interest of simplicity, the concentration of trivalent chromium was held at a low value and regarded as constant during the experimental work. This left four independent variables to be investigated.

Unfortunately, not all of the variables in chromium plating are at their optimum value for the same set of conditions. Also, other factors arise which prevent any further increase of a desirable trait. For example, throwing power might be increased in most cases by the use of lower sulfate to chromic acid fractions were it not for the brown stains which occur on the deposits when the sulfate content is too low for the amount of chromic acid present.

It is important, therefore, that optimum relationships be established between all variables which effect throwing power and efficiency as well as the relationship between the dependent variables. Also, when a certain condition cannot be set at its optimum value, it is important to know how and in what degree other factors must be changed in order that a more desirable chromium plate be obtained.

EXPERIMENTAL

If, for any reason, the concentration of chromic acid cannot be restored after having been depleted by either drag-out or electrolysis, it becomes necessary to determine what changes must be made in temperature and current density in order that a bright chromium deposit be produced. Since the sulfate is depleted only by drag-out, means must be found whereby more of the sulfate can be removed from the electrolyte. This must be done in order to restore the sulfate/chromic acid fraction to a value which gives good throwing power. Since barium salts are used to precipitate sulfates in analytical work, it was used to precipitate the excess sulfates in the test plating baths. It was found that barium hydrate was the best because it added no harmful anions to the bath as shown by the following chemical reaction:

$$Ba(OH)_2 + H_2SO_4 = BaSO_4 + 2H_2O$$

or ionically

$$Ba^{++} + SO^{--}_4 = BaSO_4$$

Even though barium hydrate is very good in effecting precipitation of sulfate, it is important to know how nearly quantitative the reaction is in the presence of chromic acid and also whether or not the plating bath is operable after the treatment.

Two methods of approach to the overall problem were designed. The first method consists in preparing fresh baths of known chromic acid concentration and varying the sulfate content with additions of sulfuric acid. For each concentration of both chromic acid and sulfate, the throwing power and current efficiency are determined at constant temperature.

The second method consists in preparing a standard plating bath of known chromic acid concentration and relative proportion of sulfate to chromic acid. The bath is then electrolyzed at a predetermined current density and temperature. At regular intervals, it is analyzed and the throwing power and current efficiency determined. The electrical interval chosen for these experiments is 100 ampere-hours per liter of solution. When the bath has been worked to lower the metal content sufficiently that there is a marked decrease in throwing power, the sulfate/chromic acid fraction is readjusted to its original value by precipitation of the excess sulfate with barium hydrate. This procedure supplies the characteristics of chromium plating baths for a continuous series of concentrations at constant temperature, as well as the effects of varying the sulfate/chromic acid fraction and its readjustment. By referring to the results obtained by the first method, the

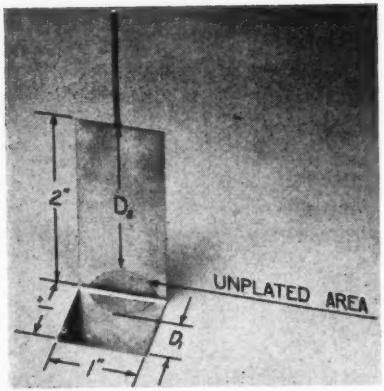


Fig. 3. Throwing power test panel

characteristics at other temperatures can be predicted.

The methods of taking and analyzing data as well as the physical dimensions of the experimental equipment were the same for both methods as it was both desirable and necessary to correlate the results.

A two-liter volume of electrolyte was used in the experiments. Tests were conducted in a 5 x 5-inch square two-liter beaker with anodes on two opposite sides. Each anode measured 4 x 6 inches. For efficiency tests, the cathode was spaced equidistant from each anode. Efficiencies were determined by weighing the amount of chromium deposited upon a 1½ x 2-inch steel panel during the passage of one ampere-hour of electricity.

Throwing power was determined by the use of a standard bent cathode. The cathode was made by bending a 1 x 3 inch copper strip, 0.022 inch thick, in a die to the dimensions shown in Fig. 3. The inside radius of the bend is $\frac{1}{32}$ inch.

When such a panel is plated with chromium, there is a tendency for the metal to deposit only along the outer edges and at the ends of the legs where the current density is highest. This leaves an oval-shaped unplated area at the intersection of the legs, also shown in Fig. 3. The size of the unplated area shows the ability of the plating bath to deposit metal over an irregular object. Consequently, it is a measure of the throwing power as defined here. By measuring the minimum distance (D_1) in sixteenths of an inch from the outer edge of the short leg to the edge of the unplated area, a scale of throwing power is obtained with a range of 0 to 16—16 representing the maximum throwing power measurable on this scale. The distance (D_2) from the edge of the long leg (Fig. 3) is also measured because sometimes it affords a means of distinguishing between two degrees of throwing power which measure nearly the same on the short leg. During plating, the short or horizontal leg of the cathode was

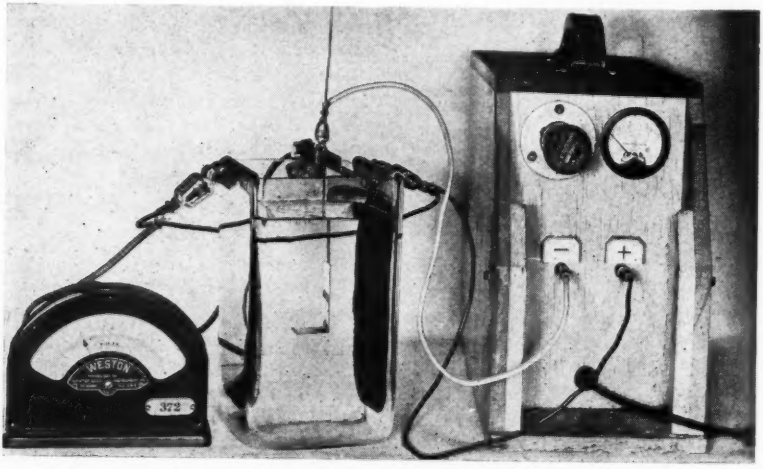
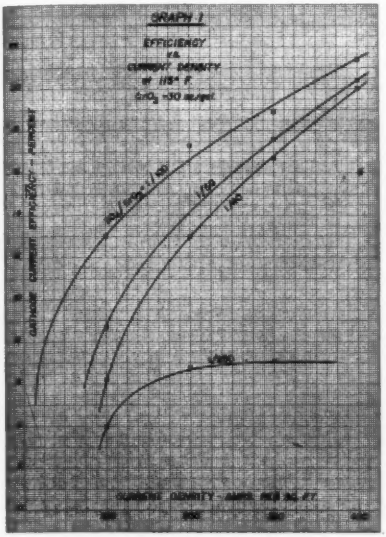


Fig. 4. Equipment ready for throwing power determination

centered between the anodes as shown in Fig. 4. The quantity of electricity passed to each throwing power test panel was 300 ampere-minutes per square foot of cathode area.



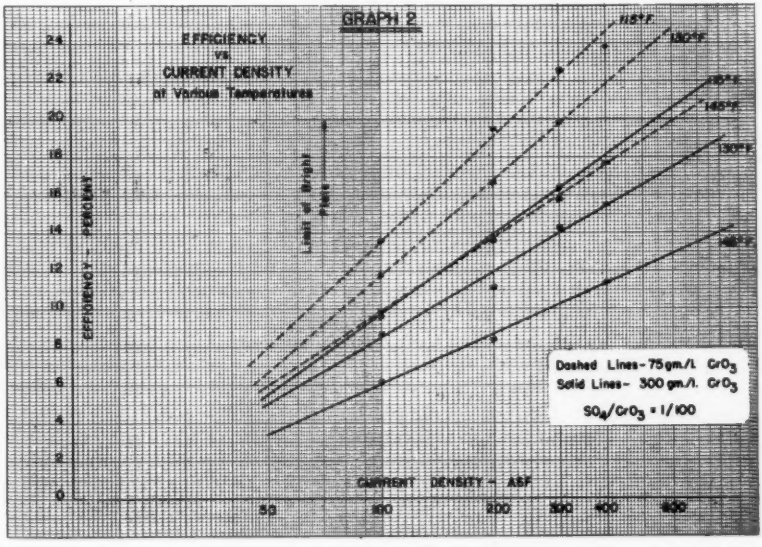
The values for the independent variables to be investigated were selected to be within a practicable plating range. Values of 10, 20, 30 and 40 oz/gal (75, 150, 225 and 300 g/l) were the chosen concentrations of chromic acid. Higher concentrations were not investigated because it was doubtful whether any production baths existed or could be prepared with more than 40 oz/gal chromic acid in view of the shortage of this material. Furthermore, drag-out losses would be extremely high from more concentrated plating baths.

Temperatures selected were 115°, 130° and 145° F. Lower temperatures were omitted because of the danger of burnt deposits at high current densities. Higher temperatures cause very low efficiencies.

Sulfate/chromic acid fractions were varied from 1/300 to 1/40. These values covered the field well and exceed operating limits at both ends. Cathode current densities used for every determination of efficiency and throwing power were 100, 200, 300 and 400 asf.

RESULTS WITH FRESHLY PREPARED SOLUTIONS

The results obtained with freshly prepared solutions shall be considered first. It must be borne in mind that four independent variables are present at all times. When plotting the variation of either of the two dependent variables—efficiency and throw-



ing power—against any one of the two dependent variables, it is necessary to hold the other three constant. In the following graphs, however, one or two of the variables are held constant while the others are used as parameters. This procedure gives a set or "family" of curves on each graph and makes it possible to include more information on one chart. The use of parameters also permits more direct comparison of data in that it puts comparative data on the same system of coordinates. Sometimes two parameters are used, giving two sets of curves on the same chart when it does not interfere with clarity.

Effect of Current Density on Current Efficiency

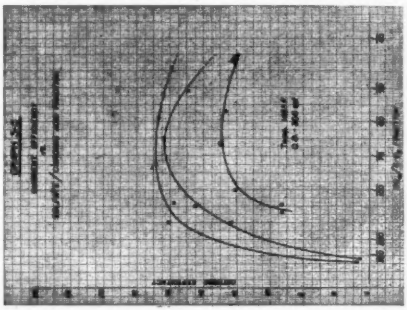
Graph 1 shows the variation of current efficiency with current density when chromic acid concentration and temperature are held constant at 30 oz/gal and 115° F, respectively. The sulfate/chromic acid fraction is used as a parameter, giving a set of curves for the specified proportions.

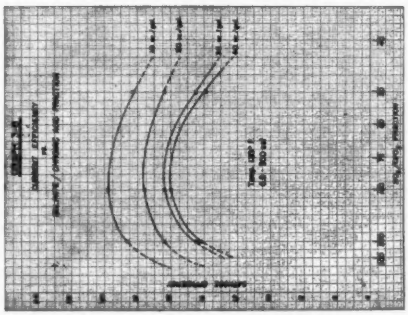
From the efficiency standpoint, it is clearly evident that a fraction of 1/100 is the most desirable. As will be shown later, the optimum value of the fraction depends upon the concentration of CrO_3 in the electrolyte.

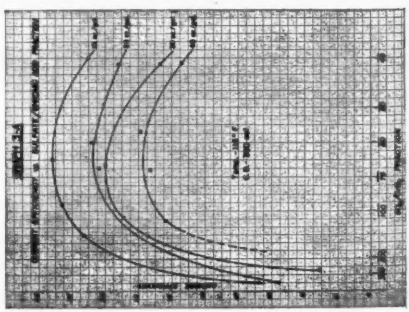
It is sometimes desirable to use a non-linear scale for one of the variables when plotting data. The shape of the curves in Graph 1 suggests logarithmic variation and, therefore, the use of a logarithmic scale might prove useful. Graph 2 is a plot of efficiency versus current density with the latter plotted to a logarithmic scale. On this system of coordinates, the curves in Graph 1 would become straight lines. The advantage of the transformation of coordinates in this case is to make it possible to draw and extrapolate the curves more easily. The lines of Graph 2 are for a constant SO_4/CrO_3 fraction of 1/100, with temperature and chromic acid concentration as parameters. The two extreme values of concentration investigated, 75 and 300 g/l (10 and 40 oz/gal), were selected to be plotted in Graph 2. Values of efficiency for any concentration between these limits would lie between the solid lines for a particular temperature and the corresponding broken line for the same temperature. Shown also as a horizontal dotted line at 20% efficiency is the upper limit of the range within which bright deposits are obtained. Above this line the deposits are burned.

Effect of the SO_4/CrO_3 Fraction on Efficiency

The next three charts, Graphs 3A, 3B and 3C, are a closely related set in that the temperature is the only variable that is changed. The current density for this set has been held constant at a representative value of 300 asf. These curves show the variation of efficiency with sulfate fraction

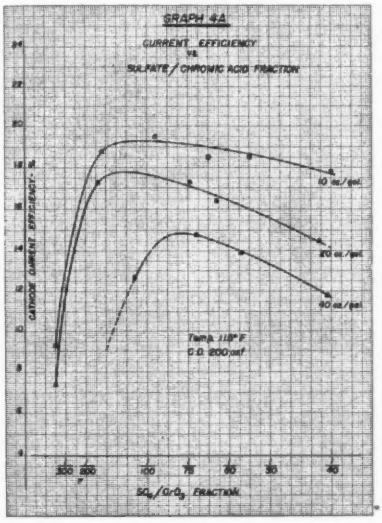


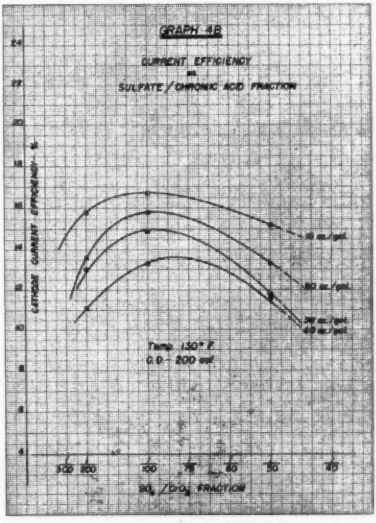




for each concentration of CrO_3 investigated.

Conclusions that can be drawn from a study of these charts are: (1) a decrease in chromic acid concentration is accompanied by an increase in efficiency; (2) for any particular concentration, there is an optimum value of the SO_4/CrO_3 fraction which gives maximum efficiency; (3) in general, this optimum value shifts toward lower values of the fraction with decreasing chromic acid concentrations. However, the change is slight and does not always occur at extremely low concentrations. Considering Graphs 3A, 3B and 3C together, with temperature as the variable, one finds that (4) there is a decrease in efficiency with an increase in temperature.





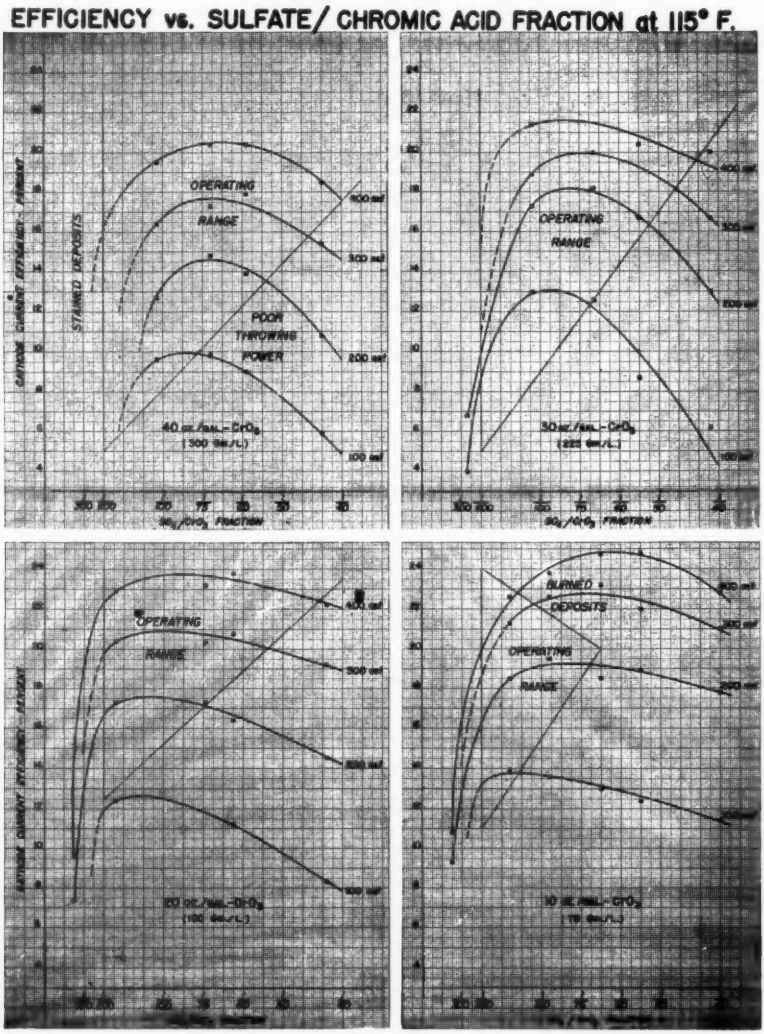
Graphs 4A and 4B are similar to the Graphs 3A, 3B, 3C series, except that the current density has been reduced to 200 asf. They are included to show that the previous conclusions hold also for the lower current density.

Graph 5 consists of four complete charts placed together for ease of comparison. As in Graphs 3A, 3B, 3C, 4A and 4B, the current efficiency is plotted against the SO_4/CrO_3 fraction, but in this case current density is used as the parameter on each chart. The variable that changes from chart to chart is the concentration of CrO_3, starting with 40 oz/gal and decreasing to 10 oz/gal. As was shown in previous graphs, high efficiencies are associated with high current densities. However, the main reason for plotting the curves for the several current densities is to show what portion, if any, of the curves lie in the operating range. This range, outlined by the dotted lines, is limited at low values of SO_4/CrO_3 fraction by the appearance of brown stains on the deposits. At high sulfate content, it is limited by poor throwing power. The upper limit in the high efficiency region is determined by the occurrence of burned deposits. However, this limit is not reached with the current densities used in these tests except in electrolytes of very low concentration, in this case 10 oz/gal CrO_3.

It is quite evident that the operating range becomes narrower as the concentration of chromic acid is decreased. The four charts taken collectively, like Graphs 3A, 3B, 3C, and 4A and 4B, also show the increase in efficiency with decreasing chromic acid concentrations.

From a study of the previous charts, it can easily be seen what happens to cathode efficiency when plating conditions are varied and the extent to which these variables can be changed and still produce good plating results. However, the conditions

GRAPH 5



which give maximum efficiency do not necessarily promote good throwing power. In fact, some of the conditions which increase efficiency actually decrease throwing power.

Effect of Current Density on Throwing Power

First, it is well to consider what might be expected from a chromium plating bath in the way of throwing power. Fig. 5 shows the degrees of throwing power obtained from what may be called a standard plating bath at 100, 200, 300 and 400 asf using the method described. The composition of the standard bath was 30 oz/gal (225 g/l) chromic acid with a SO_4/CrO_3 fraction of 1/100. The test panels were plated at a temperature of 130° F. On the basis of the scale employed, the panels from left to right

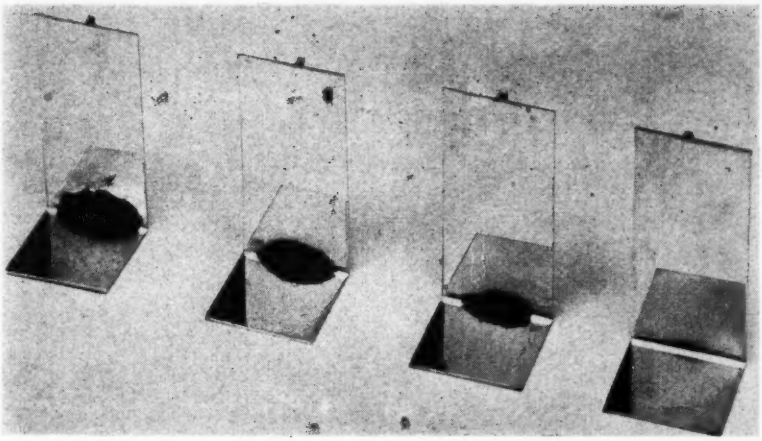
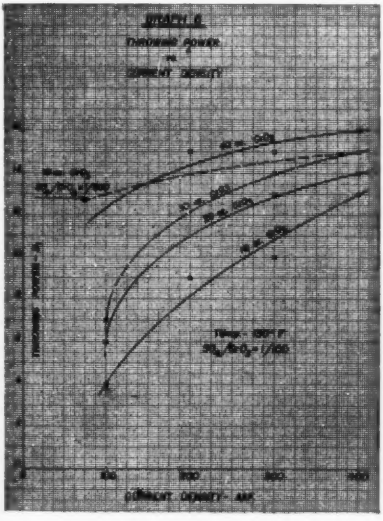


Fig. 5. Throwing power test panels after plating at (from left to right) 100, 200, 300 and 400 asf

how throwing powers of 13, 14, 15 and 16 respectively. The panel on the extreme right may be said to have been plated under conditions that give perfect throwing



power on this scale. The panel on the extreme left represents a degree of throwing power which is still acceptable but which is at the lower limit of the range of good throwing power.

Graph 6 shows a plot of throwing power versus current density for various concentrations of CrO_3, the temperature and SO_4/CrO_3 fraction being held constant at 130° F and 1/100 respectively. Like efficiency, throwing power increases with current density but, on the other hand, it decreases with decreasing CrO_3 concentrations. The relative position of the curves on Graph 6 are opposite to the corresponding efficiency-current density curves. Thus, for any increase in throwing power, efficiency must be sacrificed and vice versa. The position of the broken line on Graph 6 shows that the throwing power of a dilute bath (10 oz/gal) can be increased by a change in the sulfate content.

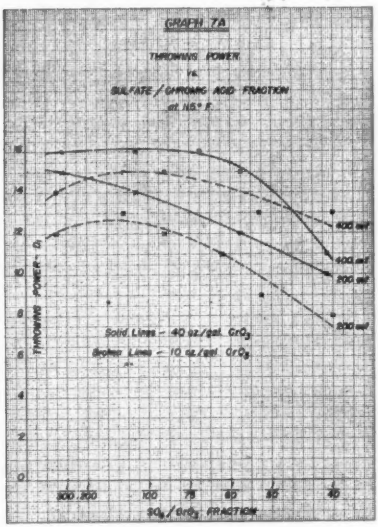
Effect of Sulfate and Temperature on Throwing Power

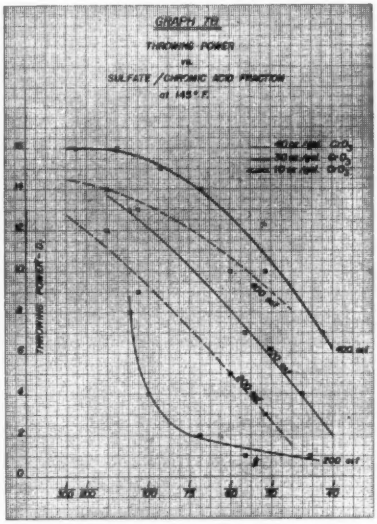
The actual variation of throwing power with changes in the SO_4/CrO_3 fraction is given in Graphs 7A and 7B for temperatures of 115° F and 145° F respectively. Current density and chromic acid concentration are used as parameters on these charts, giving two sets of curves on each. The general shape of all the curves shows that the throwing power decreases with increasing SO_4/CrO_3 fraction. Some of the curves exhibit maxima and show a decrease in throwing power at extremely low sulfate content. It is probable, however, that all

the curves would show this same tendency, were it possible to determine the throwing power at very low values of the SO_4/CrO_3 fraction. The appearance of a brown or iridescent stain, however, makes it difficult, if not impossible, to evaluate throwing power in this region.

At 115° F (Graph 7A), the throwing power of the plating bath containing 40 oz/gal is higher than that of the bath containing only 10 oz/gal at corresponding current densities. However, at 145° F (Graph 7B), the condition is reversed and values for the throwing power of a 40 oz/gal bath lie below those for a 10 oz/gal bath. Shown also on Graph 7B is a throwing power curve for a bath containing 30 oz/gal chromic acid. It lies well above either of the other curves at corresponding current density. This indicates that there is an optimum concentration of chromic acid in the neighborhood of 30 oz/gal that gives maximum throwing power at this temperature (145° F).

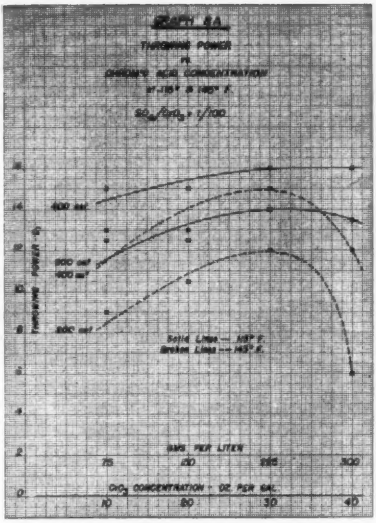
Considering Graphs 7A and 7B together, it will be seen that throwing power is much more sensitive to changes in SO_4/CrO_3 fraction at 145° F than at 115° F, i. e., for fractions above 1/100 (high sulfate content) the throwing power drops rapidly when the temperature is high. This may be attributed to the natural tendency of the throwing power to decrease with increasing temperature coupled with the decrease caused by increasing sulfate content. The greater stability of the throwing power at low SO_4/CrO_3 fractions is put to use when it is necessary to employ a high temperature to overcome low conductivity. Such a condition occurs when dilute plating baths are used.

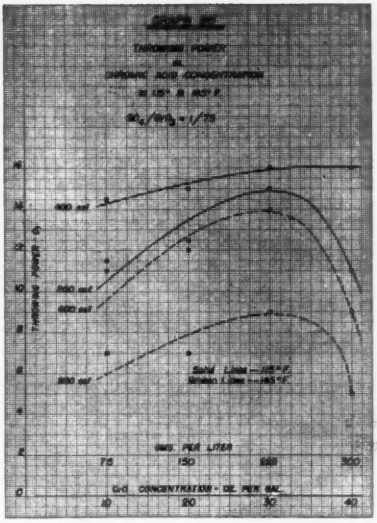




Effect of Chromic Acid Concentration on Throwing Power

As was mentioned in connection with Graph 7B, there is an optimum chromic acid concentration that gives maximum throwing power for a particular set of conditions. Graphs 8A and 8B show the actual variation of throwing power with chromic acid concentration for the two extreme values of temperature investigated. At 145° F the optimum concentration of CrO_3 lies in the neighborhood of thirty ounces per gallon. The SO_4/CrO_3 fraction for the curves of Graph 8A was held constant at 1/100, while the fraction for Graph 8B is 1/75. Curves for both values are given to show that they have relatively the same shape in the region where a small change in sulfate content produces a large effect on throwing power (see Graphs 7A and 7B).

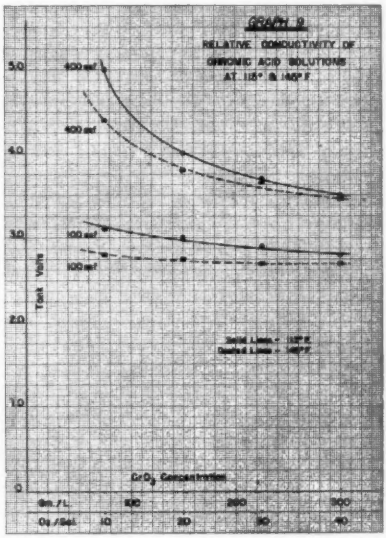




As might be expected when the adverse effect of high temperature on throwing power is considered, the variations of throwing power with chromic acid concentration is greater at the higher temperatures. This is shown by a comparison of the broken and solid curves in Graphs 8A and 8B.

Effects on Tank Voltage

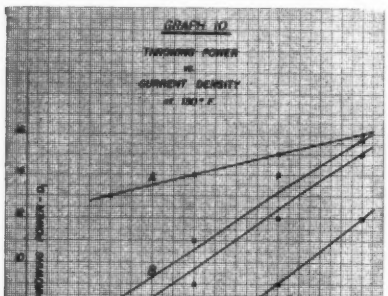
Even though it may be possible to deposit bright chromium plates from dilute chromic acid solutions, it is important to consider the increase in voltage required when the concentration is low. Graph 9 shows the change in tank voltage with concentration at two temperatures, 115° and 145° F. The increase in tank voltage at 100 asf is small as the concentration decreases from 40 to 10 oz/gal—of the order of 11% at 115° F and 4% at 145° F. At 400 asf the percentage increase is somewhat larger—43% at 115° F and 26% at 145° F. If it were necessary to operate a chromium plating bath of low concentration, it would also be necesary to use the higher temperature. It must be remembered that the values of tank voltages and percentage increases shown on Graph 9 and mentioned above, are strictly relative and may not necessarily be the same for different equipment. Absolute values of tank voltages will vary with the physical dimensions of the setup as well as with the anode to cathode area ratio and the type of electrical contacts.



RESULTS WITH "WORKED" SOLUTIONS

Up to this point, all of the data has been obtained from freshly prepared solutions. It is now important to see how this

data compares with that taken from electrolytes that have been "worked". Plating baths to furnish such data were obtained by preparing an electrolyte of relatively high concentration (40 oz/gal) and electrolyzing it until the concentration decreased to the desired point. Earlier in this article



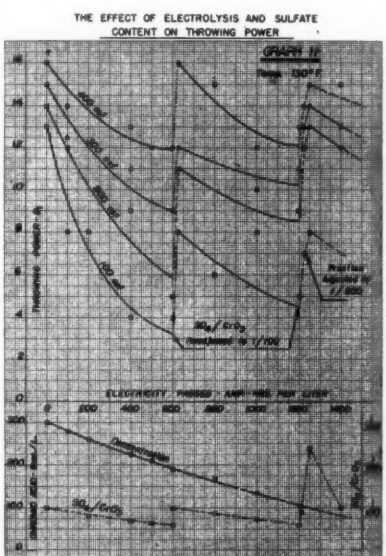
we designated this experimental work as the second method of approach.

Graph 10 illustrates some of the results obtained by this method. Line "A" represents the throwing power of a freshly prepared standard bath (composition—300 g/l CrO_3 and $SO_4/CrO_3 = 1/100$). Line "D" represents the throwing power of the same electrolyte after it has been electrolyzed for a sufficient length of time to cause the concentration to fall to 191 g/l and the fraction to change to 1/63. When the SO_4/CrO_3 fraction has been readjusted to approximately 1/100, the throwing power increases to the values represented by line "B". Line "B" corresponds well with line "C" which represents the throwing power of a freshly prepared electrolyte having nearly the same chromic acid concentration and SO_4/CrO_3 fraction. These results help emphasize the fact that proper control of the SO_4/CrO_3 fraction is of paramount importance when maximum throwing power is desired.

The continuous change in throwing power of a chromium plating bath as it is electrolyzed is shown in Graph 11. Also, at the bottom of Graph 11 is a plot of the concentration versus the amount of electricity passed. The concentration decreases uniformly with continued electrolysis. Since the sulfate content remains constant, the SO_4/CrO_3 fraction changes as shown by the dotted line. After the passage of 600 ampere-hours of electricity per liter of solution which caused a marked decrease in throwing power, the SO_4/CrO_3 fraction was readjusted to 1/100 by precipitation of the excess sulfates with barium hydrate. The reaction associated with this precipitation is nearly quantitative in the chromic acid solutions. The decrease in sulfate content is accompanied by an increase in throwing power at the corresponding point. After the readjustment, electrolysis was continued.

This again resulted in a decrease in con-

THE EFFECT OF ELECTROLYSIS AND SULFATE CONTENT ON THROWING POWER



centration and a change of the SO_4/CrO_3 fraction and, consequently, in a decrease in throwing power. When the fraction had been again readjusted to 1/100, the change in throwing power was repeated. The increase was not as great as before but, nev-

ertheless, appreciable. From Graphs 7A and 7B it may be recalled that throwing power increases with decreasing SO_4/CrO_3 fraction. Applying this knowledge to the present situation, one should be able to increase the throwing power further by decreasing the amount of sulfate. When the SO_4/CrO_3 fraction was decreased to slightly below 1/200, the throwing power did show a marked increase. Upon further electrolysis, the throwing power began to decrease as before. After passage of 1400 ampere-hours of electricity, the concentration had decreased to approximately 75 grams per liter. This is considered the low limit and electrolysis was discontinued.

Referring again to Graph 11, one finds the throwing power, except at low current densities, still within the acceptable range for an electrolyte of this concentration and a SO_4/CrO_3 fraction of 1/100. It may be added at this point that the equilibrium values of trivalent chromium concentration in the "worked" baths were low enough that its effect could be regarded as inappreciable.

SUMMARY

The use of dilute chromium plating baths is neither necessary nor recommended. However, when this work was begun, there was evidence of what appeared to be a prolonged shortage of chromic acid. Since much of the information obtained is of both academic and commercial interest, it has been correlated and assembled in this article.

Two related methods for determining the characteristics of chromium plating solutions have been described. The first method was the preparation and study of freshly prepared electrolytes in which were determined the effects of concentration, SO_4/CrO_3 fraction, temperature and current density on the two dependent variables, current efficiency and throwing power. Data were then obtained by the second method with "worked" baths of various concentrations. The range of concentrations was covered by electrolysis of a bath of originally relatively high chromic acid content. As the concentration decreased with continued electrolysis, the characteristics were determined at uniform intervals.

The complete range of SO_4/CrO_3 fractions was not covered by the second method, but the change in the value of the fraction was sufficient to show its marked effect upon throwing power. Only one temperature was investigated in the "worked" baths. However, the agreement between the results obtained by the two methods is good enough to permit to be predicted results from "worked" baths at other temperatures. The same agreement also indicated that barium hydrate can be used successfully in the control of the sulfate ion in chromium plating baths.

CONCLUSION

Satisfactory bright chromium deposits can be plated from electrolysis containing as little as 10 oz/gal (75 g/l) of chromic acid, provided changes are made simultaneously in other plating conditions. The current efficiency of chromium plating solutions increases with decreasing chromic acid concentration. However, the temperature must be raised to counter-balance the decrease in conductivity. The fraction of sulfate concentration to chromic acid concentration should, in general, be lower than usual in order that the decrease in throwing power associated with low concentrations and high temperatures be overcome. The low limit of the fraction is determined by the appearance of brown or iridescent stains on the deposits. The upper limit is determined by the lowest throwing power that can be tolerated. The "operating range" as set by these limits becomes smaller as the concentration of chromic acid decreases.

As long as the concentration of trivalent chromium remains low in chromium plating baths, the results obtained from "worked" baths agree well with those from freshly prepared solutions. As the concentration of chromic acid in "worked" baths decreases, it is necessary to adjust the sulfate/chromic acid fraction by precipitation of the excess sulfates. This can be accomplished successfully with barium hydrate.

BUT...

Old fashioned methods are costly. That's why it pays to use the best available modern products when preparing metal surfaces for painting.

CHEMICALS ACP PROCESSES

RUST PROOFING AND PAINT BONDING

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Lithoform
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GRANODINE* & DURIDINE are fast, efficient workers. They reduce production costs, save time, minimize paint outlay.

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*Trade Mark Reg. U. S. Pat. Off.

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Sound Cost Control Procedures in the JOB PLATING BUSINESS

By RAYMOND J. O'CONNOR

CONTRACT PLATING COMPANY — BRIDGEPORT, CONN.

Introduction

The consideration of sound cost control procedures in the plating business is particularly opportune today for a number of reasons.

In the first place, the granting of the current demands of labor for an increase in basic wages will have a profound effect on total costs in industry. In some businesses, a rise in wages might mean only a small increase in total cost and could be given without substantial dislocation of their financial affairs. However, in the job plating business, the amount of wages and salaries paid to shop, office and supervisory employees is approximately 50 per cent of the sales dollar. Almost any increase in wages and salaries would require a substantial increase in selling prices if the same dollar profit is to be maintained.

Therefore, if wages are increased anywhere near the percentage suggested by labor, many businesses (and I include metal finishing businesses) will have to have reliable cost information or they will face a severe loss of earnings.

In the second place, it is generally agreed that postwar business will be extremely competitive. The lax operating habits developed during the war will not be easy to adjust. Like all habits, they were easy to acquire but are difficult to correct.

As a result, platers will have to bestir themselves to bring the organization back to a competitive, cost-conscious basis. A sound cost plan will provide the foundation for the corrective educational program.

In the third place, the metal-finishing industry has developed into a sizable business in which many more dollars are being handled than before. This factor and the many new problems encountered—government regulations in particular—have made it imperative that careful consideration be given to organizational and financial controls.

From the foregoing, it is apparent that the average metal finisher should become thoroughly acquainted with the cost aspects of his business.

Type of Cost Control Plan

Whole most will readily agree, in light of what has been said here, to the need for vital information, there are many who will feel that cost control is largely red tape. Unfortunately, there have been and are a number of so-called systems which produce a great many figures that have very little value to the hard-boiled plater. That some systems have bogged down does not mean that all control plans are inapplicable to the plating business. We speak from experience when we say that a sound plan, installed some years ago, has been very helpful in the analysis of our operations and the formulation of new policies.

A very important factor to bear in mind is that every business is different and that any new control plan must be tailored to fit the peculiarities of each company. The one who designs the plan must not only be an accountant but must also understand many of the practical manufacturing problems of the business in question. With such background he can prepare information in a form that the supervisory staff can use to locate and correct any adverse trends.

A sound cost control procedure should provide three things:

1. The basis for costing each product.

2. The basis for evaluating inventories, and
3. Control figures to indicate in what department or division performance has been poor.

While it is absolutely necessary that any cost plan be specifically designed to meet the needs of each particular company, there are, however, a number of fundamental principles which should underlie each control plan. In other words, the fundamentals are the same, but the details vary in each case, depending upon the amount of money to be controlled as well as the complexities of the problems involved.

At this point we wish to outline and then describe in detail the various elements which go into the development of the cost of any product sold. Later we will show how an estimate is prepared from these cost elements as well as explain how actual performance is reconciled with estimates.

According to accepted sound cost accounting practices, an estimate is developed using the cost elements listed in Fig. 1.

COST TERMS USED IN PREPARING ESTIMATE

1. Direct Material	XX
2. Direct Labor	XX
3. Manufacturing Expenses	XX
4. Factory Cost	XX
5. Selling Expenses and Administration Expenses	XX
6. Total Cost	XX
7. Standard Profit	XX
8. Standard Selling Price	XX

Fig. 1.

1. *Direct Material* is the material which is used directly in the manufacture of the finished product and which it is practical to measure. Those materials which are difficult to measure from a practical standpoint are known as indirect materials and are included in the Manufacturing Expense category.

It is obvious that what in some shops is considered as a Direct Material might be classed as an indirect material in other shops. For instance, some large plating plants having volume barrel production on a few items, would consider as Direct Material anodes, salts, sodium cyanide, and acids; while in a small job plant these items would be part of the Manufacturing Expense.

2. *Direct Labor* is the labor that is applied directly to the finished product, and which is practicable of measurement. As in the case of indirect material, labor which is applied to the finished product but is difficult to measure clerically on each job, is known as indirect labor and is included in the Manufacturing Expense.

Also, as in the case of indirect materials, some labor in a large shop might be construed to be Direct Labor while in a smaller shop it would be considered as indirect labor.

3. *Manufacturing Expense* includes all factory costs that cannot be classified as either Direct Material or Direct Labor. In some shops it would include:

1. Salts and chemicals
2. Acids
3. Rent
4. Power
5. Light
6. Gas
7. Water
8. Depreciation of building
9. Depreciation of machinery and equipment
10. F. O. A. and Survivors Insurance
11. Fire insurance
12. Excise tax
13. Property tax
14. Supervision
15. Janitor
16. Overtime premium
17. Spoilage
18. Maintenance
19. Miscellaneous supplies
20. Inventory adjustment

4. *Factory Cost* is the sum of Direct Material, Direct Labor, and Manufacturing Expense.

In costing Manufacturing Expense, the primary consideration is to ascertain how much Manufacturing Expense is necessary to operate the plant for each productive or Direct Labor dollar or hour. This relationship is usually expressed as a percentage, for instance 150 per cent, which means that for each Direct Labor dollar necessary to produce a product, $1.50 must be added to cover Manufacturing Expense.

The correct application of Manufacturing Expense in the costing procedure is so important that failure to follow sound practice might throw estimated cost out of line considerably—in either direction. A very careful investigation should be made of the manufacturing operations in each plant so that the shop may be divided into natural departments as far as Manufacturing Expense is concerned. This is done because in many plants the amount of Manufacturing Expense per Direct Labor dollar varies considerably between departments.

Assume, for example, the situation shown in Fig. 2. It would be disastrous to apply only $1.25 to each Direct Labor dollar to cover Manufacturing Expense if a very large order was being estimated which called for all of the work to be performed in Department A.

5. *Selling and Administrative Expense* includes:

1. Shipping
2. Royalties
3. Office Clerks
4. Telephone
5. Printing and stationery
6. Dues and subscriptions, etc.

In the preparation of an estimate, these expenses are covered by applying a percentage to the Factory Costs.

6. *Total Cost* equals the sum of the Factory Cost plus the Selling and Administrative Expense.

7. *Standard Profit* is the amount of profit the management wishes to make on each class of work and is arrived at by applying a predetermined percentage to the total estimated amount of Direct Labor and Manufacturing Expense (Direct Material not included) in the estimate.

8. *Standard Selling Price* is the sum of the Total Cost and the Standard Profit.

It is to be noted that the standard percentages used in application of Manufacturing Expense, Selling and Administrative Expense, and Standard Profit are very carefully determined before the cost plan is inaugurated. Each month thereafter, the actual figures for these groups are determined and compared with the standard percentages. Two factors have a bearing on any differences between the actual and standard values of these percentages:

1. The volume of business expressed in Direct Labor dollars, and
2. The effectiveness of control of each group of expenses.

This variation will be discussed later in connection with controls.

MANUFACTURING EXPENSE PER DIRECT LABOR DOLLAR

	Total	Dept. A	Dept. B
Manufacturing Expenses	$5.000	$3.000	$2.000
Direct Labor Dollars	$4.000	$1.500	$2.500
Rate M.E./D.L.D.	$1.25	$2.00	$0.80

Fig. 2.

Description and Operation of Cost Plan

The type of cost plan, which is suitable for most medium and small metal finishing plants, is known as the "Estimated Cost System."

In this system, a Standard Estimate is prepared for each item sold, showing the estimated amounts for Direct Material, Direct Labor, Manufacturing Expense, Sales and Administrative Expense and Standard Profit. At the end of the month a comparison is made between the Total Cost at

which the finished products were estimated and their actual Total Cost. This comparison is made by cost elements and any substantial variation between the actual and estimated costs is investigated.

It is readily noted that as long as the actual and estimated costs are very close, little attention is paid to them. However, a large difference signals the management that something is wrong and should be investigated. A considerable amount of time is saved because only the out-of-line cost elements are checked.

The diagram of the flow of costs shown in Fig. 3 is helpful at this time. The precise accounting procedure is not stressed in this illustration as is the fundamental concept that the variations in operating costs are to be highlighted for the information of the management. In actual practice, a separate variation account would be created for each cost element of Direct Material, Direct Labor, Manufacturing Expense and Selling and Administrative Expense.

Fig. 3.

Perhaps the most important form used in this cost plan is the Standard Estimate

Form. The preparation of an actual standard estimate is illustrated in Fig. 4.

In the Standard Estimate Form are shown customer's name, part number and description, quantity to be finished and the exact finishing specification. The form is divided into the elements of Factory Cost and the added a predetermined Standard Profit percentage and the resulting figure becomes the Standard Selling Price. This divided by the number of units under consideration will then give the unit price per piece or per thousand pieces.

It might be well to consider in detail the

STANDARD ESTIMATE

Company A Customer Date 10/30/45

Part 1"x1"x.03125 Bracket Quantity 1750# (100.000 Pcs)

Cadmium pl. .0005" plus 1 coat prime

Direct Material .0005"cd. (.3107#) /cu. in.						
6 sq. In./pc. x 100.000 93.21# @ .95						88.55
Red. Primer (50-50) 25 gal. @ 1.75						43.75
1. Total Direct Material Cost			5% waste			6.62 / 138.92
Direct Labor Cost	Hrs.	Rate per Hour	Direct Labor Cost	Dept. Overhead %	Mfg. Expense	Total Direct Labor$ Mfg. Exp.
Dept. A - Barrel Plate Cleaning & Deburring	3.0	.65	1.95			
Plating & Drying	11.7	.90	10.53			
2.			12.48	150%	18.72	31.20
Dept. B - Still Tank Plating						
3.						
Dept. C - Pol. & Buffing						
4.						
Dept. D - Lacquering Tray & Turn	20.0	.60	12.00			
Spray & Dump	16.6	.90	14.94			
4-A			26.94	90%	24.25	51.19
Dept. X Anodizing						
5.						
6. Total Factory Cost 1 + 2 + 3 + 4 + 5						221.31
7. Selling & Administrative Expense 25%						55.33
8. Total Cost						276.64
9. Standard Profit 2 + 3 + 4 + 5 x %						20.60
10. Standard Selling Price						297.24

Selling Price $2.97/m pcs.

Fig. 4.

labor is further subdivided departmentally so that different departmental overhead rates can be applied to the respective Direct Labor cost in the several departments. After the total Factory Cost figure has been arrived at, a percentage is applied to this for Selling and Administrative Expense, resulting in a Total Cost figure. To this is

specific example in Fig. 4 so that the various steps in the estimating procedure will be more clearly understood.

There are 100,000 pieces of a U-shaped bracket, 1" x 1" x 0.03125" thick to be cadmium plated in a barrel to a thickness of 0.0005 inch. Following cadmium plating, the part is to be sprayed with an air-drying

material. The first step is to determine the Direct Material cost. In this case, the cadmium metal and the paint and reducer are considered Direct Material. Measurement of the piece will disclose that there are approximately six square inches of surface to be plated. The area involved in any small holes can be disregarded as it is more or less offset by the area of their edges. There are several ways of determining the surface area of parts to be plated. In the *Plating and Finishing Guide Book* published by the Metal Finishing this year, there is outlined a relatively simple method for arriving at the effective plating area of metal stampings which appears sufficiently accurate for the purpose of practical cost determination. Use is made of charts and all that is required is the actual weight of the part in either grams or ounces and its thickness. The surface area in square feet is read directly from the chart. In order to find the amount of cadmium to be used, we first must determine its volume. Since there are 100,000 pieces and each piece comprises six square inches, there is roughly 600,000 square inches of surface to be treated. The thickness, 0.0005 inch, multiplied by the area results in 300 cubic inches of cadmium metal. Reference to a table of the physical properties of metals will indicate that there is 0.3107 pound of cadmium per cubic inch. This factor multiplied by the number of cubic inches, 300, gives a usage of 93.21 pounds of cadmium. This figure, in turn, multiplied by the price of cadmium, namely 95 cents per pound, gives a total cadmium cost of $88.55.

Consider now the amount of primer and reducer required. On the assumption that the piece will be hand sprayed on trays and that it is possible to fit 200 pieces on a tray, and from previous study of similar parts, it is determined that 50 trays of parts can be sprayed on both sides with one quart of material mixed half and half. Since there are 100,000 pieces to be sprayed, our estimated primer consumption is 100 quarts or 25 gallons of mixed material. With a unit price of $1.75 per gallon at the gun, we extend our paint material cost at $43.75. This added to the cadmium material figure plus a 5 per cent factor for waste, etc., comes to a total Direct Material cost of $138.92.

Next we turn to the Direct Labor cost section of the Standard Estimate Form. In the Barrel Plating Department there are two distinct operations: cleaning and deburring, and plating and drying. In considering the first operation, let us assume that one man at the rate of 65 cents per hour is able to take care of six oblique tumblers. If 100 pounds of parts will make a workable charge for the barrel, it is estimated that the cleaning and deburring operation will consume three hours of the operator's time. This results in a Direct Labor charge for cleaning and deburring of 3 times 65 cents or $1.95. The second operation is plating and drying. On the basis that one man at a rate of 90 cents per hour takes care of three plating barrels and that 50 pounds makes a barrel batch for one hour's run, 150 pounds of these parts will be plated each hour. Since 1,750 pounds are to be plated, the Direct Labor charge becomes 11.7 hours at 90 cents or $10.53. Hence the total Direct Labor charge is $12.48 in this department. Assuming that the departmental overhead rate on Direct Labor is 150 per cent, the Manufacturing Expense or overhead figure is $18.72. The total Direct Labor and Manufacturing Expense for the barrel plating operations therefore, is $31.20.

Now consider the operations performed in the Lacquering Department. Again, from previous time study of identical operations on similar parts, it has been determined that one operator can tray and turn 25 trays per hour. At 200 pieces per tray this results in an hourly production of 5,000 pieces or 20 hours for the job. With a base pay of 60 cents per hour, a Direct Labor charge of $12.00 is arrived at for this operation.

In estimating the spraying operation, we find by referring to previous time studies on similar parts that one man can spray and dump 30 trays or 6,000 pieces per hour. Hence 16.6 hours are required to do the job. A pay rate of 90 cents per hour makes for a Direct Labor charge of $14.94 for

this operation. This charge plus the $12.00 for traying and turning results in a total Direct Labor cost in the Lacquering Department of $26.94. Assuming that the overhead rate in this department is 90 per cent, the Manufacturing Expense charge becomes $24.25 and the total for labor and overhead $51.19.

We have seen that Factory Cost is the sum of Direct Material, Direct Labor, and Manufacturing Expense. Referring to the Standard Estimate, we find that the Factory Cost is $221.31. Assuming that the Selling and Administrative Expense amounts to 25 per cent of the Factory Cost, the charge is $55.33 for this item. To it we add a predetermined profit percentage on the Direct Labor and Manufacturing Expense. The sum of these results in a Standard Selling Price of $297.24. This figure divided by the number of pieces gives a unit price per thousand pieces of $2.97.

In estimating finishing costs on still tank plated work, the same general procedure is followed. Caution must be exercised in estimating the Direct Labor cost to make certain that all operations performed on the parts are included.

Because of the many variables involved, we find it desirable to put through samples before any final estimate of polishing cost is arrived at. The job is broken down by operations and a time study is made with the stop watch. In actual production, piecework rates are used and the rate on the job then becomes the fixed Direct Labor cost.

Because materials are difficult to measure accurately, such polishing items as greaseless compound, tripoli, lime, etc., are included in Manufacturing Expense. This item, as has been stated before, is expressed as a percentage of the Direct Labor cost.

Record of Completed Work

In addition to the Standard Estimate Form, one other record is necessary to carry out this cost plan, namely a form which shows the work completed and priced at the estimated cost. A sample of the form is shown in Fig. 5.

RECORD OF COMPLETED WORK

Dept. _____ Date _____

Customer	Name of Item	No. of Units	Est. Cost Per Unit	Total Est. Cost
A	1"x1" x .03125" Bracket	50 M	$2.21	$110.50
	Total For Month			XX

Fig. 5.

At the end of each month, the estimated cost of work completed during the month in all departments is totalled. This amount is credited to the Work in Process Account and debited to the Finished Goods Account.

Return to Efficient Performance

There is little doubt that the metal finishing industry will have to put its house in order if it is to meet the competition just

ahead. In view of the Administration's policy to resist increases in selling prices and the substantial increases in operating costs encountered since 1942, many metal finishers, who were just getting by before the war, will have to take drastic steps or face serious consequences.

Without prompt and accurate cost information, the average plant has little hope of survival. It is, therefore, essential that any accounting plan which is installed do more than develop the correct profit or loss data. It must also provide figures which can be used to locate excessive costs and in so doing provide sufficient detail that the management can guide the supervisory staff responsible for the performance in taking corrective measures.

The Estimated Cost System which we have described here not only sets up a standard or "bogey" for each cost element but also permits comparison between the actual performances and the standards at the end of each month.

In the development of bogeys, the actual working methods are analyzed so that the standard will be predicated upon the best possible method. Wherever practicable, we strongly endorse the use of a wage incentive plan to measure Direct Labor. In the process of making time studies, opportunities for improved methods are noted which, if adopted, will increase the output with the same or less effort. For instance, when the incentive plan was being installed in our Lacquering Department, a change in nozzle pressure was found to enable the operator to cover the same area with half the number of strokes and with half the material cost due to less waste in overspray. Also, in the same department, the analysis showed that by lengthening the drying oven, the work flow would become more uniform, and as a result the number of girls required to set up and turn trays was reduced.

The incentive plan not only provides the basis for the estimates in the cost plan, but also the basis for measuring the effectiveness of the productive personnel. Segregated by the individual foremen, those employees producing less than the estimates can be easily detected.

The introduction of a wage incentive plan should be preceded by the installation of a job evaluation plan. The latter is nothing more than a common-sense method of arriving at the worth of each job to the company. The following are some of the factors considered:

1. Skill
2. Responsibility—to product and machine
3. Working conditions

NEED OF JOB EVALUATION PRIOR TO WAGE INCENTIVES

	Present Rate	Evaluated Rate	25% Bonus on Present Rate	25% Bonus on Evaluated Rate
Job A	.90	.70	1.125	.875
Job B	.60	.80	.75	1.00

Fig. 6.

The result of an evaluation study nearly always shows that some jobs are overpaid while others are underpaid. It is very important to the management that the correct amount be paid for each job because overpayment is an excessive cost and underpayment induces the more efficient help to go to competitors. The maximum should be paid for each job on the basis of its value in relation to other jobs.

It was stated above that job evaluation should be done before wage incentives are installed. The example in Fig. 6 indicates the reasons for this.

It is obvious that if Column 1 does not

represent the true value of the Jobs A and B, Column 3 figures distort even more the relation between value and wage.

How close one can adhere to the Standard Estimate of Direct Material depends upon two factors. One is the quantity of material used and the other the price paid for the material.

All raw material should be kept in the storeroom and dispensed only upon presentation of a requisition. Only small quantities to cover one or two days' requirements should be issued to the operating departments at any time. In our particular case, a substantial saving was made when we moved the materials from the departments into a fenced-in storeroom. Not only were our materials kept in a neater way, but we acquired more working space in the operating departments.

A standard purchase price is developed for each Direct Material and the standard price is always used in the preparation of standard estimates. If a purchase is made which differs in price from the standard, a variation is set up on the books to denote the difference. If the purchase price is less than the standard price, the variation is positive; if higher, negative.

If work is spoiled, necessitating additional Direct Material, a record is made of this on the requisition so that it will be charged to a spoilage account in the Manufacturing Expense rather than to the Direct Materials account.

In the case of both Direct Material and Direct Labor, the comparisons between actual and estimated costs are made for the month's production as a whole, rather than for each individual job. Only in instances where the monthly results show a large variation does the management make any further analysis. One exception to this is when a very large order is being handled, in which case spot checks are made throughout the run.

This type of cost system offers excellent opportunity of reducing costs through control over Manufacturing Expense. All are well aware of the fact that as volume of business increases, the percentage of Manufacturing Expense to Direct Labor cost usually decreases. In many cases, the favorable variation due to increase in volume can be so large that it overshadows poor handling of this expense.

In the discussion of the use of the Standard Estimate, it was stated that a standard percentage is calculated which is applied to Direct Labor cost to cover Manufacturing Expense. It is obvious that the percentage holds true only for a certain amount of expense at a certain Direct Labor cost. This Direct Labor cost is known as normal output or capacity.

The choice of the capacity figure for each department is very important. It should be based on the average output over at least a year's time. A budget of expenses is prepared for each department and the departmental amounts are divided by their respective normal Direct Labor cost to arrive at the standard percentage for each department.

Fig. 7 is an actual example from our own operation which illustrates how the standard percentages were developed for the Barrel and Lacquer Departments.

Flexible Budgets

The question of controlling Manufacturing Expense has, for a long time, been considered as one which was almost impossible of solution. Because of the fixed character of a number of items in this category—like rent, taxes and insurance—the reduction of output by a certain percentage does not carry with it an equal reduction in Manufacturing Expense.

In recent years, many companies have made analytical studies of Manufacturing Expense, and have found ways to reduce some of the items by from 5 per cent to 30 per cent. They subdivided the expenses by departments for two reasons: (1) to localize them and (2) to associate them with the supervision responsible for the operations by which they were incurred.

It was found that there are three types of overhead expenses, as follows:

1. Fixed expenses, which do not change regardless of output.

2. Variable expenses, which fluctuate in direct proportion to changes in output. If

STANDARD MANUFACTURING EXPENSE DISTRIBUTION

ACCOUNT NAME	TOTAL	BARREL	STILL	POL. & BUFF	ENAMEL & LACQUER	ANODIZING	FACTY. OFFICE & RECEIVING	GENERAL FACTORY	LABORATORY	MAINTENANCE	STORE ROOM	BUILDING
INDIRECT LABOR												
FACTORY LABOR FOR SAMPLES												
SUPERVISION		$436.36			$315.92							
CLERICAL WORK												
REPAIRS		453.76			15.15							
JANITOR & WATCHMEN												
IDLE TIME					4.76							
OVERTIME PREMIUM		938.66			176.75							
INDIRECT LABOR		226.56			133.00							
BONUS		350.55			205.33							
	$960.17	$2305.89	$1296.82	$252.72	851.80	$492.34		$2669.03	$1240.63	$350.53	$147.41	
INDIRECT MATERIAL												
ACIDS & SALTS		1365.64										
SODIUM CYANIDE		210.40										
CLEAN. MAT'LS. & SAWDUST		310.45			14.20							
ALL OTHER MATERIALS		1016.20			123.67							
	$740.98	$2902.69	$9609.31	$42.84	$137.87	$610.95		$206.27	$31.58	$102.44	$478.00	$280.03
INDIRECT EXPENSE												
FUEL OIL-PROCESS		329.60										
POWER		670.03			75.29							
GAS, WATER & LIGHT		124.00			110.93							
FREIGHT & CARTAGE												
DEPRECIATION-B.M&E		211.03			33.80							
INSURANCE		91.83			20.88							
TAXES		237.13			102.51							
MISC. EXPENSE		51.85			50.40							
ROYALTIES												
INVENTORY ADJUSTMENTS												
MISC. TOOLS		705.95			157.72							
	$6814.55	$2421.42	$1016.69	$243.56	$551.53	$1111.86		$637.07	$93.56	$245.79	$175.57	$317.50
GRAND TOTAL	$23823.70	$7630.00	$4922.82	$539.12	$1541.20	$2215.15		$3512.37	$1365.77	$698.76	$800.98	$597.53
BUILDING	597.53	244.13	113.40	34.80	49.20	18.60	68.40	13.80	13.80	20.40	21.00	$597.53
STORE ROOM	821.98	403.18	270.80	4.00	96.80	42.40		4.80			$821.98	
MAINTENANCE	719.16	238.20	157.68		7.92	67.68		247.68		$719.16		
LABORATORY	1379.57							1379.57	$1379.57			
GENERAL FACTORY	5158.22	1877.02	1528.80	182.00	795.60	774.80		$5158.22				
OFFICE & RECEIVING	68.40	25.40	19.93	2.44	10.37	10.26	$68.40					
TOTAL	$238.23.70	$10417.93	$7013.43	$762.36	$2501.00	$3128.89						
DIRECT LABOR DOLLARS	19258.00	6945.00	7013.00	1270.06	2779.00	1251.00						
% MFG. EXP./D.L.D.		150 %	100 %	60 %	90 %	250 %						

Fig. 7.

the output is doubled, these expenses double and if the output is reduced by 25 per cent, they are reduced by 25 per cent, etc.

3. Semi-variable expenses, which fluctuate with output changes, but not in the same proportion. If the output increases by 100 per cent, these expenses may increase only by 60 per cent, and if the output decreases by 50 per cent, they may be reduced by 25 per cent, etc.

It was explained in the previous section that in preparing Standard Estimates, Manufacturing Expense was figured on a departmental basis at normal capacity which is usually considered as 100 per cent output. However, the expense was only applicable for the one level of activity—normal. To take care of outputs larger and smaller than normal capacity, Flexible Budgets have been created. A Flexible Budget is merely a schedule of expenses for all levels of activity, and a budget of this type is prepared for each department.

FLEXIBLE BUDGET

BARREL DEPARTMENT

ACCOUNT NAME	20%	60%	100%	140%	180%
INDIRECT LABOR					
FCTY LABOR FOR SAMPLES					
SUPERVISION	$436	436	436	436	436
CLERICAL WORK					
REPAIRS	171	312	454	595	737
JANITOR & WATCHMAN					
IDLE TIME					
OVERTIME PREMIUM	50	150	939	1314	1689
INDIRECT LABOR	122	174	227	279	332
BONUS	50	150	250	351	451
	829	1222	2306	2975	3645
INDIRECT MATERIAL					
ACIDS & SALTS	273	820	1366	1912	2458
SODIUM CYANIDE	42	126	210	294	379
CLEAN MATERIALS - SAWDUST	62	186	311	435	559
ALL OTHER MATERIALS	203	610	1016	1423	1829
	580	1742	2903	4064	5225
INDIRECT EXPENSE					
FUEL OIL PROCESS	130	230	329	430	529
POWER	254	462	670	878	1086
GAS - WATER - LIGHT	49	86	124	161	199
FREIGHT & CARTAGE					
DEPRECIATION - B M & F	211	211	211	211	211
INSURANCE	92	92	92	92	92
TAXES	237	237	237	237	237
MISC. EXPENSE	14	33	52	71	90
ROYALTIES					
INVENTORY ADJUSTMENTS					
MISC. TOOLS	141	424	706	988	1271
	1128	1775	2421	3068	3715
TOTAL DIRECT CHARGES	2537	4739	7630	10107	12585
DISTRIBUTED CHARGES					
BUILDING	49	147	244	342	439
STORE ROOM	81	242	403	564	726
MAINTENANCE	48	143	238	334	429
LABORATORY					
GENERAL FACTORY	375	1126	1877	2628	3378
OFFICE SALES	5	15	26	36	46
GRAND TOTAL	$3095	6412	10418	14011	17603
DIRECT LABOR (DOLLARS)	1389	4167	6945	9723	12501
% MFG. EXP / D.L.D.	222.8%	153.9%	150%	144.1%	140.8%

Fig. 8.

A Flexible Budget has been prepared for the Barrel Department, a copy of which is shown in Fig. 8. It is to be noted that the rate of Manufacturing Expense per Direct Labor dollar at normal output (100 per cent) is $1.50. At outputs smaller than 100 per cent, the rate is higher than $1.50, while

at outputs larger than 100 per cent, the rate is lower than $1.50.

It should be pointed out that the Manufacturing Expense rates for the different outputs are based upon the assumption that the budgeted expenses will be met. If the supervision does a better job than the budget calls for, the Manufacturing Expense rate will be lower than the budgeted rate shown on the chart. On the other hand, if the performance is less efficient than the budgeted requirement, the Manufacturing Expense will be higher than that shown on the chart.

The example in Fig. 9 will help to clarify this point. Assume that the Barrel Department actually operated at 180 per cent activity or capacity with $12,501.00 Direct Labor cost, and that the actual Direct Manufacturing Expense was $14,260. One will recall that in preparing our Standard Estimates, 150 per cent of the Direct Labor was figured to cover Manufacturing Expense. Expense by $1,675 ($14,260 less $12,585). Consequently, while we gained by virtue of high activity, the net result relative to the estimated expense was a loss of $524.91 ($1,675.00 less $1,150.09) because the department exceeded its budgeted allowance for direct Manufacturing Expense.

In this case, the management would press the supervision to find the reason for the excess cost.

One of the important advantages of the flexible type of budget is that no matter what the volume (as expressed in Direct Labor cost) in any department, the management has informed the supervisor in each department how much money is allowed for each expense item. Therefore, it also provides a yardstick to measure the effectiveness of the supervision insofar as its handling of overhead expense is concerned.

Based upon the performance relative to these budgets, a bonus plan can be developed for the supervision. Use of such a

MANUFACTURING EXPENSE VARIATION

ACTIVITY 180%

DIRECT LABOR DOLLARS	$12501
BUDGETED M.E. / D.L.D.	1.4008%
ACTUAL TOTAL DIRECT CHARGES	$14260
BUDGETED TOTAL DIRECT CHARGES	$12585

VOLUME GAIN

$12501.00 (D.L.D.) × (1.50 − 1.4008) = $1150.09

PERFORMANCE

$14260. − $12585 = $1675. LOSS

NET RESULT

$1675.00 − $1150.09 = $524.91 LOSS

Fig. 9.

Referring to the Flexible Budget for the Barrel Department in Fig. 8, we note that the budgeted rate (Mfg. Exp. per D. L. D.) at 180 per cent capacity is 140.8 per cent, and the budgeted direct Manufacturing Expense is $12,585. Therefore, there has been a gain of $1,150.09, (150 per cent − 140.8 per cent) x $12,501.00, due solely to the large volume put through the shop during the month.

However, the actual direct Manufacturing Expense in this department was higher than the budgeted direct Manufacturing plan can result in savings to the company of many times the amount of the bonuses.

Profitgraph

I believe that the management of each company should prepare a Profitgraph like the one illustrated in Fig. 10. It shows the relation of costs and selling prices at all volumes of activity and the "break-even" point of the business.

From this graph, a flexible profit and loss budget can be prepared with the amount of each cost element as well as the profit

at each level of activity. Fig. 11 gives an example of such a budget.

The graph permits management to visualize almost instantly the result of any change in selling prices on the "break-even" point and on the profits at different levels of business activity. Such knowledge will be very valuable when keen competition is restored and the temptation to marginal companies to increase sales volume by reducing selling prices becomes great.

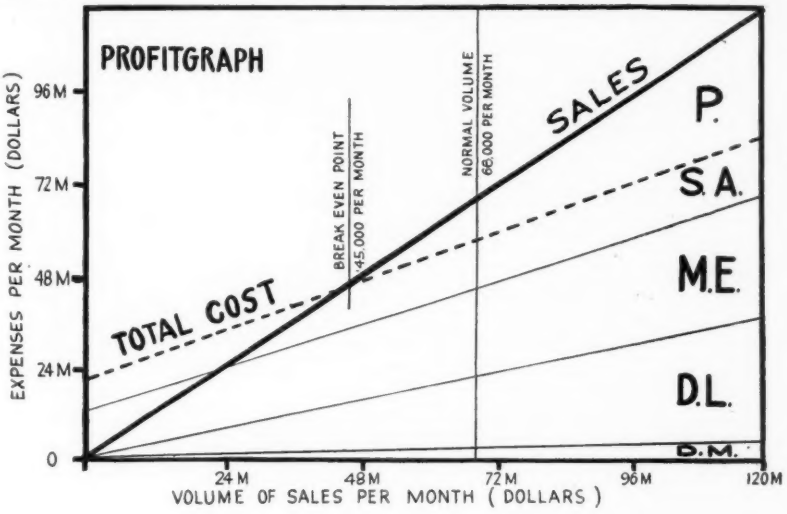

Fig. 10.

Profit and Loss Statement

The Profit and Loss Statement is, perhaps, the most important document that management receives because it gives the net results of the business for the period in question. A Profit and Loss Statement should be prepared every month and should be in the hands of the management not later than ten days following the end of the month.

The form of the statement is very important. The one shown in Fig. 12 sets

FLEXIBLE PROFIT & LOSS BUDGET

		20%	% OF SALES	60%	% OF SALES	100%	% OF SALES	140%	% OF SALES	180%	% OF SALES
1	NET SALES	13360	100.0	40080	100.0	68,000	100.0	93520	100.0	120240	100.0
2	DIRECT MATERIAL	500	3.7	1500	3.7	2500	3.7	3500	3.7	4500	3.7
3	DIRECT LABOR	3820	28.6	11460	28.6	19100	28.6	26740	28.6	34360	28.6
4	MFG. EXPENSE	15210	113.8	19260	48.1	24120	35.5	27180	29.1	31493	26.2
5	FACTORY COST	19530	146.1	32220	80.4	45720	67.8	57420	61.4	70373	58.5
6	GROSS PROFIT (1-5)	-6170	- 46.1	7860	19.6	22280	32.7	36100	38.6	49867	41.5
7	S+A EXPENSE	7920	59.3	9630	24.0	11160	16.4	13590	14.5	15127	12.6
8	TOTAL COST (5+7)	27450	205.4	41850	104.4	56880	84.2	71010	75.9	85500	71.1
9	PROFIT (1-8)	-14090	-105.4	-1770	- 4.4	11120	16.3	22510	24.1	34740	28.9
10	% ME EXP (4) to DL (3)		398.2		168.1		126.3		101.6		80.6
11	% SA EXP (7) to FC (5)		40.6		30.0		24.4		23.7		21.5
12	% PROFIT (9) to DL (3)+ME (4)		-73.0		- 5.8		25.7		41.7		52.7

Fig. 11.

PROFIT AND LOSS STATEMENT
Month of September 1945

	BARREL	STILL	ENAMEL-LACQUER	POL.-BUFFING	ANODIZING	TOTAL
1. Actual Sales	XX	XX	XX	XX	XX	XX
2. Less Variation (Act. S.P.-Std. S.P.)	XX	XX	XX	XX	XX	XX
3. Standard Net Sales	XX	XX	XX	XX	XX	XX
4. Less Standard Cost of Sales	XX	XX	XX	XX	XX	XX
5. Standard Gross Profit	XX	XX	XX	XX	XX	XX
6. Less Standard Sales & Admr. Expense	XX	XX	XX	XX	XX	XX
7. Standard Net Profit	XX	XX	XX	XX	XX	XX
8. Less Variation						
Direct Labor			XX			
Material Price			XX			
Direct Material Quantity			XX			
Mfg. Expense-Volume			XX			
Mfg. Expense-Controllable			XX			
Sales & Admr.-Volume			XX			
Sales & Admr.-Control			XX			
Total Variation			XX			XX
9. Actual Net Profit at Standard Selling Prices						XX
10. Less-Variation (Act. S.P.-Std. S.P.)						XX
11. Actual Net Profit at Actual Sales Prices						XX

Fig. 12.

forth clearly the pertinent facts. For instance, it will be observed that the effect of selling prices on profit is recorded. The Standard Net Profit, as indicated in the Standard Estimates, will be made if the actual and estimated values of each cost element are the same. Assume that the Standard Net Profit for the month was figured at $2,500. Also assume that the sales at Standard Selling Prices should be $25,000 and, because of competition, the Sales Department sold the products for $22,000. The actual net result for the company as a whole would be a $500 loss, and unless the sales price variation was actually understood, it might be assumed by the management that the plant was operating inefficiently.

Actually, the plant produced on budget, and as far as supervision was concerned, the company should have made $2,500. The management would then have to decide whether the concession in selling price should be continued in light of the overall result.

The solution of the cost problem in the metal finishing industry, we believe, will be found when the practical plater, as well as the supervisory plater, learns both to pay strict attention to the executive part of his activities and to keep a weather eye on the Profit and Loss Statement.

BOOK ON "LANHAM ACT"

W. H. Anderson Company, law book publishers of Cincinnati, Ohio, have announced the publication of the first book on the new trade-mark act—*Trade-Mark Act of 1946*, by *H. A. Toulmin, Jr.*, of Dayton, Ohio. (Price delivered, single copies, $5.00—10 or more copies, $4.00 each.)

This act, known as the *Lanham Act*, is the first comprehensive law enacted for the protection of trade-marks in the United States.

The author is a well-known authority on trade-mark law and the author of previous trade-mark books and articles, and counsel for a large number of corporations on trade-mark matters. He is a member of the law firm of *Toulmin and Toulmin*, of Dayton, Ohio, and Washington.

Workmen's Compensation

How to save money on workmen's compensation insurance—a 16-page compilation of case histories illustrating how a saving of 37.9% was achieved by the average of all companies using the A. S. C. S. Plan, has just been published by *Associated Safety and Claims Services, Inc.*, 123 William Street, New York 7, N. Y. Copies are available on request.

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FINISHING METAL PRODUCTS, by Herbert S. Simonds and Adolph Bregman, 2nd Edition, 1946, XII + 352 pages. McGraw-Hill Book Company, Inc., New York, N. Y. Price, $4.00.

To cover the whole of the metal finishing field in a book of medium size is an ambitious undertaking as well as a formidable task. Simonds and Bregman have succeeded remarkably well in their attempt to do so. Their volume, if perused from cover to cover, will give the reader at least a nodding acquaintance with practically every useful method of metal finishing. In addition there is some material which is not available so compactly anywhere else in the literature.

It is gratifying to find that the authors present their wealth of information in a simple, forthright style which makes for easy reading. The illustrations are numerous, clearly reproduced and appropriate to the text. Throughout the book the authors are acutely conscious of the economic aspects of metal finishing.

The first part of the book is concerned with the commercial viewpoints of finish and appearance, and deals with such topics as sales value of attractive finishes, importance of color, prefinished raw materials, etc. This section may be of more direct interest to designers and sales managers than to the practical plater, but the latter could well know at least something along these lines.

The following two parts, comprising about one-third of the book, is devoted to a thorough discussion of polishing, buffing, cleaning and other steps in the preparation of metals for finishing operations. These chapters appear to be the most valuable contribution which the authors have to offer in this book. Not only are the processes concerned described in detail from an up-to-date viewpoint (which includes automatic equipment), but about twenty pages are used to discuss the cost and value of cleaning and how to minimize cleaning expense. Two particularly interesting chapters deal with the designing of products to reduce polishing expense, and the design of polishing and buffing fixtures.

The fourth part of the book covers the plating and spray coating of the common metals. This is a generalized discussion and does not delve deeply into the details of operation although there is an interesting presentation of a complete finishing cycle involving copper and nickel plating. A chapter is devoted to electroplating costs and estimating. The concluding chapters of this part of the book include brief descriptions of a number of processes for applying metallic coatings by methods other than electroplating.

The uses of organic coatings, including paints, are discussed in part five. In about fifty pages the authors present a compact summary of the relative values and possible applications of many types of organic coatings.

The book is concluded with a short chapter on the coloring of aluminum and another on porcelain enamels.

It is felt that, while the treatment of most subjects is adequate, somewhat more attention should have been given to the various black oxide coating processes and to the general subject of phosphate treatments.

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Developments in Tin and Tin Alloy Coatings

ERNEST S. HEDGES. *Chemistry and Industry*, **1945**, 370–373; *Chem. Abstracts*, **40**, 2075 (1946).

The porosity of tin electroplates, as determined by the thiocyanate test, may vary 30 to 1 depending on how the steel basis is prepared. The acid sulfate bath gives the best coatings if the steel is carefully cleaned; the stannate bath is less sensitive to differences in cleaning. The corrosion resistance of tin plate is greatly improved by treatment with a hot alkaline chromate solution containing a phosphate and a wetting agent. For paint adhesion, tin deposits on steel are as good as phosphatization; the best results are with 0.00003 inch tin from the stannate bath. For tinning cast iron, a dip in a molten nitrate bath after pickling removes the surface graphite, and the resultant cavities provide an excellent bond. Tin-zinc alloy deposits show a general corrosion resistance better than that of tin, zinc, or cadmium; best results are with 78% tin. The bath is a hot alkaline solution of sodium stannate and zinc cyanide, with alloy anodes of the composition of the coating. In the salt-spray test, a coating 0.0003 inch thick gives as much protection as 0.003 inch hot-dipped zinc coating. A chemical filming treatment improves the corrosion resistance even further. The coating withstands considerable deformation, and can be readily soldered. Copper-tin alloy, speculum, deposits containing 40 to 45% tin are hard, white, and easily polished. They do not tarnish but remain bright for years indoors. The stannate bath contains sodium cuprocyanide and an excess of NaOH and NaCN. Separately controlled tin and copper anode circuits are used because an alloy anode can be dissolved only at low current density.

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●

Electrolytic Polishing of Cadmium

JACQUES LIGER. *Bull. Soc. Chim.*, **11**, 568–572 (1944); *Chem. Abstracts*, **40**, 1097 (1946).

Cadmium is electropolished in a bath containing 120 g/l KCN and 20 g/l $Cd(OH)_2$, with a current density of 111–140 asf. Best results are obtained without stirring the electrolyte or moving the electrodes.

ERNEST H. LYONS, JR.

●

Electroplating During the War I

E. A. OLLARD and E. B. SMITH. *Chemical Age*, **54**, 633–638 (1946).

Protection of steel parts; barrel plating; tropical requirements; cartridge cases; building up machine parts; lubrication of surfaces; indium infusion; tin plating.

A Glossmeter for Smoothness Comparisons of Machine-Finished Surfaces

B. S. HUNTER. *Optical Soc. Am.*, **36**, 178–181 (March 1946).

Since shininess is one indication of surface smoothness, a photoelectric glossmeter was developed for possible use in production inspection of the roughness of machine-finished surfaces with between 100 and 500 micro-inches root-mean-square deviation from mean surface. Because this roughness is about one thousand times the smallest roughnesses that affect gloss, it is necessary to coat each machined surface tested with a thin film of light mineral oil which fills microscopic cracks and pores but conforms to the large surface irregularities. A near-grazing angle of 75° was chosen for the measurement so that surfaces on which there are ridges of metal between adjacent tool cuts are rated low in gloss and, therefore, rough. Although the glossmeter essentially measures the fraction of the unshadowed surface which is nearly parallel to the mean surface, the instrument has proved to be a simple and useful device for making rapid comparisons of the roughnesses of surfaces machined with about the same tool feeds.

●

Ascertaining the Thickness of Electrodeposited Gold Coatings

W. STANLEY CLABAUGH. *J. Research Natl. Bur. Standards*, **36**, 119–127 (1946); *Chem. Abstracts*, **40**, 4617 (1946).

A specimen of exactly 1 sq mm area and about 0.00050 mm thickness is made with a special punch and die. The basis metal is dissolved in a little nitric acid, and the gold residue is washed. It is then dissolved in a little aqua regia and evaporated to dryness. A solution of o-tolidine is placed on the dry residue and gold is determined colorimetrically. Full instructions are given. The results were accurate within 10%. Indicated thickness of gold plates on various jewelry articles were 1.5–14 millionths of an inch.

Painted Steel—Use of a Tin Undercoat To Improve Corrosion Resistance

ERNEST S. HEDGES and L. A. JORDAN. *Iron and Steel*, **18**, 591–594 (1945): *Chem. Abstracts*, **40**, 1323 (1946).

Priming and finishing coats of various types of paint were applied over bare and tin-coated steel, and the panels were exposed to accelerated tests and outdoor weathering. Corrosion of tin-plated panels was much less than that of unplated panels. There was not much difference between deposits from the acid and from the alkaline bath. Paint adhered better to electroplated tin than to hot-tinned coatings or to coatings flash-melted after electroplating.

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●

Chromic Acid Anodizing Solution

ANON. *Metal Industry*, **68**, 477 (1946).

Summary of a recent investigation carried out at Consolidated Vultee Aircraft Corporation. Addition of sulfuric acid to a chromic acid anodic solution produced a coating of aluminum alloy which had better corrosion-resistant properties than the film produced by the standard chromic acid bath. Main drawback is a severely corrosive effect on the linings of steel tanks, but it could be used satisfactorily with lead-lined tanks.

●

A New Silver Polishing Process

D. R. TURNER. *Materials and Methods*, **24**, 426 (1946).

The silver-plated object is immersed in a regular plating solution. Reversed current is applied for a few seconds at about four times the amperage used to plate, discontinued, then applied again. This intermittent action is repeated for several cycles until the article has reached its peak of luster. It is then rinsed and dried. The entire operation takes little more than a minute.

Pickle Brittleness of Steel

PAUL BASTIEN. *Rev. met.*, **42**, 205–217 (1945); *Chem. Abstracts*, **40**, 4331 (1946).

Killed and open ingots, formed from six different steels made in a basic open-hearth furnace and one blown in a basic converter, were drawn into wires, 2 mm in diameter, which were charged with hydrogen by pickling in 10% HCl or by cathodic pickling. Immersion in mercury at 65° F removes all hydrogen in 1000 hours; hydrogen is also removed in hot water. No difference was noted between charging by pickling or electrolytic treatment. A residual brittleness, proportional to the amount of hydrogen originally introduced, is associated with small amounts of hydrogen remaining in the structure of the steel; it depends on the permeability of the steel to hydrogen, which in turn depends on the method of making the steel. Heating of the steel to 482° F removes all hydrogen and causes progressive removal of brittleness. Armco iron is an exception; it is not charged with hydrogen or embrittled in acid pickling, but, on being charged electrolytically, it remains brittle indefinitely at room temperature.

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●

Method of Evaluating Metal Cleaners

SAMUEL SPRING, HOWARD I. FORMAN and LOUISE F. PEALE. *Metal Finishing*, **44**, 297–300 (July 1946).

Metal panels are coated with various oils by a specific dipping and drainage technique, then cleaned and rinsed according to a carefully controlled procedure. The panels are covered with a fine spray of water which condenses as droplets on the oil-covered areas and provides a pattern that remains constant for a sufficient time for a sketch to be drawn on paper divided into 100 squares. Average value for cleaned area of five panels is the cleaning efficiency index. Reproducibility is rather good. Conditions influencing results and variations in procedure are discussed.

Analysis of Zinc Cyanide Electrolyte Containing Sodium Sulfite

A. M. GUIVA. *Zavodskaya Lab.*, **11**, 617; *Chem. Abstracts*, **40**, 2416 (1946).

Dilute 25 ml of the bath to 500 ml in a volumetric flask. To 25 ml of the diluted bath, add 25 ml $Bi(NO_3)_3$. Filter off the basic bismuth sulfite precipitate. Wash the filter and precipitate with cold water. To the filtrate and washings, add 10 ml 10% KI, and titrate cyanide with 0.1 N $AgNO_3$. To determine total akalinity, add 5 to 10 ml iodine solution to 25 ml of the diluted bath to oxidize the sulfite, 25 ml potassium ferrocyanide (22 g/l) to precipitate zinc, and 25 ml 1% $AgNO_3$ to precipitate cyanide. Add 2 to 3 drops phenolphthalein, titrate with 0.2 N HCl until the pink color disappears, let stand for 1 to 2 minutes and finish the titration.

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●

Calculating Coil and Burner Requirements for Gas-Fired Immersion Heating

R. M. BUCK. *Iron Age*, **158**, 46–52 (July 11, 1946).

Essential engineering data for calculating size of immersion coils and burner input required for gas-fired immersion heating of liquids are given. The author has correlated information not previously available in one place and has supplemented this with original material. The information is applicable to pickling, plating and rinsing, solvent cleaning, waxes, soft metal, heat-treating salts, etc.

●

Procedures for Nickel Plating on Zinc Die Castings

E. J. ROEHL. *Die Casting*, **4**, 70–76 (July 1946).

Discusses A. S. T. M. specifications; casting design and specification; surface preparation and plating of zinc base die castings.

Electrolysis of Dilute Solutions of Copper Sulfate

ALBERT NICOL. *Compt. rend.*, **222**, 382–384 (1946).

Copper sulfate solutions 0.005–0.00025 N in concentration were electrolyzed with stationary and rotating platinum electrodes. The cathode deposits were blue or black because cupric hydroxide was included in the copper. The more dilute the solution, the more cupric hydroxide is deposited; and at 0.000125 N the whole deposit is oxide, unlike results with silver salt solutions. The solubilities of cupric hydroxide and cupric oxide in copper sulfate solutions were determined; these materials dissolve more rapidly from a freshly plated cathode than by shaking the solution with the solid material.

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●

Drop-Solution Method for Determining the Thickness of Zinc and Cadmium Coatings

MARCEL BALLAY and JULES GINGUENE. *Rev. met.*, **42**, 15–21 (1945); *Chem. Abstracts*, **40**, 2775(1946).

A study was made of effect of number of drops per minute, volume of each drop, temperature, angle of sample from horizontal, nature of the metal, and the curvature of the sample on the Brenner drop-test with chromic acid. The results were accurate to within approximately 10%.

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●

Finish Testing Equipment V. Wet Film Gauge

ANON. *Organic Finishing*, **7**, 41 (May 1946).

Describes film gauge by means of which thickness of wet films of finishing materials may be quickly and accurately determined. Of particular service in measuring and controlling the thickness of coatings applied by spray gun, roller coater, etc.

Chemical Nature of the Rubber-to-Brass Bond

S. BUCHAN and W. D. RAE. *Trans. Inst. Rubber Ind.*, **21**, 323–342 (1946); *Chem. Abstracts*, **40**, 4241 (1946).

A fresh brass-plating bath gives deposits which do not bond well to rubber, even though the composition and appearance of the brass meet the usual requirements. However, if electrolysis is continued, a deposit is eventually obtained which bonds well. This was shown to be due to a change in the amount of sodium cyanide which combines with copper cyanide. In the fresh bath, the molar ratio of combined cyanide to copper was 2.6, indicating the presence of both $NaCu(CN)_2$ and $Na_2Cu(CN)_3$. The ratio increased as the bath was electrolyzed; when it reached 3, good bonding deposits were obtained. If the ratio is reduced below 3 by addition of copper salts, the results are bad again. X-ray studies showed that bad brass is not uniform in structure, whereas good brass is quite uniform. After rubber had been vulcanized on the brass deposits, much more copper sulfide was found on the bad than on the good deposits. It is thought that the brass with non-uniform structure is more reactive and so forms more sulfide. It appears that the initial reaction is the formation of Cu_2S. As the reaction proceeds, the Cu_2S attaches itself directly to the rubber or to a sulfur atom combined with the rubber, thus bonding the rubber to the brass. However, Cu_2S may also react with uncombined sulfur and form CuS which has no bonding properties. If the brass reacts too rapidly, it will unite with considerable sulfur which has not as yet reacted with the rubber and is, therefore, available to form CuS and spoil the bond. It is necessary, therefore, to balance the rate of reaction of sulfur with rubber with its rate of reaction with brass. Certain active accelerators supply sulfur too rapidly to brass, form CuS, and spoil the adhesion. The function of the zinc is apparently to dilute the copper and slow down its reaction with sulfur.

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Acid Pumps

J. SPRECHER. *Engineers' Digest (American Edition)*, **3**, 277–278 (1946); Abstract from *Technische Rundschau Sulzer*, **3**, 1–9 (1945).

Gives constructional details of acid pumps made of stoneware with outer cast-iron parts and gland and glandless type pumps.

•

Soft Water Rinse Improves Aluminum Finishes

ROBERT S. HERWIG. *Iron Age*, **158**, 58, 59 (July 11, 1946).

Production is increased and rejects decreased in the electroplating or anodizing of aluminum products by use of rinse water of zero hardness after alkaline cleaning. Results from a plating installation with a water softening unit are given.

•

Glycerine in Anodic Treatment of Aluminum

GEORGIA LEFFINGWELL and MILTON A. LESSER. *Products Finishing*, **10**, 50–54 (July 1946).

Employed in varying proportions in the electrolytic bath, glycerine generally acts as an inhibiting agent, serves to prevent undue etching and thereby helps to provide a finer, whiter and smoother surface. The addition of glycerine to sulfuric acid baths is reported to decrease the solubility of aluminum and to facilitate formation of a more plastic film.

•

Electricity for the Plater XI

D. A. COTTON. *Products Finishing*, **10**, 66–78 (June, 1946).

Continues the discussion of various sources of power for electroplating. Concludes series of articles.

The Application of Oxide Coatings to Aluminum Sheet Metal Work

V. F. HENLEY. *Sheet Metal Inds.*, **23**, 1561–1567 (1946).

The author's object in writing this paper was to outline some of the properties of chemically and electrochemically produced oxide coatings as a guide to sheet metal workers proposing to use oxide-coated aluminum. He has divided coatings into two classes, those produced by immersion in suitable oxidizing solutions and those in which the oxidation is carried out by electrolytic methods. Typical examples of the first class are (a) Modified Bauer-Vogel (M. B. V.) process, (b) "Alrok" process, (c) "Pylumin" process. The second class is divided according to the type of electrolyte used; in general (a) Bengough-Stuart process using chromic acid, (b) "Alumilite" process using sulfuric acid and (c) "Eloxal" process using oxalic acid. Each process is discussed and recommendations made for using the coating most suitable for a particular application.

•

Improving Forming Processes by Phosphate Coatings

A. DURER, E. SCHMID, and H. D. VON SCHWEINITZ. *Z. Ver. deut. Ingenieure*, **86**, 15–18 (Jan. 10, 1942); *Bull. Iron and Steel Inst.*, No. **127**, 23A (July 28, 1946).

It is well known that forming operations, in particular drawing, are made easier when the steel has a phosphate coating. Laboratory tests on the drawing of steel tubes show that the good adhesion and the oil-absorption properties of the coating were the main reasons.

•

Electroplating in the U. S. A.

A. W. HOTHERSALL. *Metal Industry*, **68**, 456–458 (1946).

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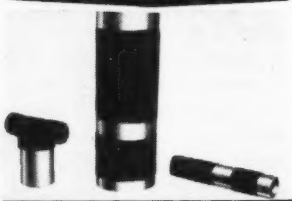

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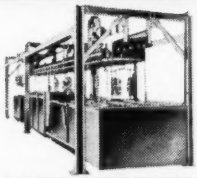
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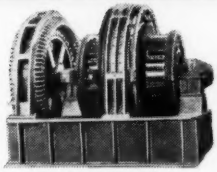
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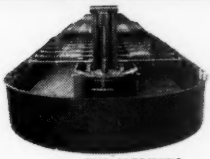
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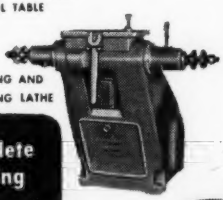
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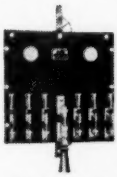
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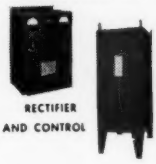
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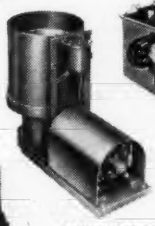
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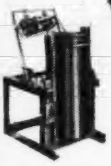
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EFFECT OF IMPURITIES AND PURIFICATION OF ELECTROPLATING SOLUTIONS

A. E. S. Research Project No. 5

I. Bibliography

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Acknowledgment is due the Research Committee, Mr. E. C. Candee, American Brass Company, Chairman; the Research Directing Sub-Committee, Dr. R. M. Wick, Bethlehem Steel Corporation, and Dr. Louis Weisberg, Consulting Chemist, New York City, Chairman and Vice-Chairman respectively; and the Project Sub-Committee, Mr. B. C. Case, Hanson-Van Winkle-Munning Company, Chairman; Mr. L. B. Sperry, Dohler-Jarvis Corporation, and Dr. R. C. Olsen, Fisher Body-Ternstedt Division, General Motors Corporation, for their contribution to this project.

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A. E. S. Research Committee Meeting

The Research Committee of the A. E. S. met on Friday, December 13, 1946 at the Statler Hotel, Detroit, Mich. With the exception of M. R. CALDWELL who was absent and excused, all other members of the Committee were present. VICE-PRESIDENT A. W. LOGOZZO and DR. G. JENISON, Weirton Steel Company, were invited guests.

The entire day was required to cover the various business activities of the Committee. The Finance Sub-Committee comprising C. E. HEUSSNER, Chrysler Corporation, *Chairman*, DR. R. A. SCHAEFER, Cleveland Graphite Bronze Company, and DR. H. L. KELLNER, Lea Manufacturing Company, made a very extensive report on the Sustaining Membership drive. The Society is fortunate in having such live wire members serving on this important Committee.

DR. R. M. WICK, Chairman of the Research Directing Sub-Committee, made a very detailed report on the Committee's activities. Project No. 1 on "Stripping of Copper from Various Base Metals" and Project No. 3 on "Methods for Determining the Adhesion of Electrodeposited Coatings" have been completed. Project No. 9 on "The Physical Properties of Electrodeposited Metals" has now been started at the National Bureau of Standards and C. W. JENNINGS is the research associate. A new Project, No. 10, on "The Disposal of Plat-

(*Continued on Page 206*)

Sustaining Members — As of Jan. 8, 1947

The annual dues ($100.00 or more) paid by the sustaining members go directly into the Society's Research Fund. This fund is used exclusively to meet direct expenses for the research projects.

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American Zinc Institute
Apex Plating Co.
Apollo Metal Works
Apothecaries Hall Co.
Arnold, Schwinn & Co.
Auto City Plating Co.
C. A. Barnes & Sons
Bastian-Blessing Co.
Bell Telephone Laboratoires, Inc.
Belke Manufacturing Co.
Berteau-Lowell Plating Works
Bethlehem Steel Co.
Brown & Bigelow, Inc.
Brown-Hutchison Iron Works
Buckingham Products Co.
Canadian Hanson-Van Winkle Co.
Carey-McFall Co.
Chase Brass & Copper Co.
Christie Plating Co.
Chrome-Rite Co.
Chromium Corporation of America
Chromium Process Co.
Chrysler Corp.
Cinch Manufacturing Corp.
Cleveland Graphite Bronze Co.
Clinton Co.
C. G. Conn Co., Ltd.
Corona Corp.
Crown Rheostat & Supply Co.
Darco Corp.
Daystrom Corp.
Dayton Rustproofing Co.
Detrex Corp.
A. B. Dick Co.
Dixie Electro Plating Co.
Doehler-Jarvis Corp.
R. R. Donnelly & Sons Co.
Dow Chemical Co.
E. I. du Pont de Nemours & Co.
Dura Co.
Dura-Chrome of Chicago, Inc.
Eastman Kodak Co.
Eaton Manufacturing Co.
Electric Auto-Lite Co.
Electrolux Corp.
Electrolux (Canada), Limited
Ellmore Silver Co., Inc.
Erie Plating Co.
Federal Mogul Corp.
Federal Telecommunication Laboratories
J. H. Feeley
Flour City Ornamental Iron Co.
Ford Motor Co.
Formax Manufacturing Co.
Frigidaire Div., General Motors Corp.
E. R. Frost Co.
Gemex Corp.
General Chemical Co.
General Electric Co.
General Motors Corp.
Gerity-Adrian Manufacturing Co.
Gordon Manufacturing Co.
Gorham Manufacturing Co.
Grand Rapids Metalcraft Corp.
Great Lakes Plating & Japanning Co.
Frederick Gumm Chemical Co.
Hammond Machinery Builders Co.
A. H. Hannon
Hanson-Van Winkle-Munning Co.
Harshaw Chemical Co.
Haviland Products Co.
Heil Engineering Co.
Hodecker Bros.
Hohman Plating Co.
Houdaille-Hershey Corp.
Hub Plating Works
Hudson Motor Car Co.
Hunter Pressed Steel Co.
Hy-Grade Plating Co.
International Business Machines Co.
International Nickel Co.

International Silver Co.
F. L. Jacobs
Kelite Products, Inc.
Kelly Plating Co.
Kings Electroplating Co.
Knape & Vogt Manufacturing Co.
Kocour Co.
Kollsman Instrument Div., Square D Co.
Lasalco, Inc.
Lea Manufacturing Co.
Lionel Corp.
Mass & Waldstein Co.
MacDermid, Inc.
P. R. Mallory & Co., Inc.
Matchless Metal Polish Co.
Mattatuck Manufacturing Co.
Maxson Co.
McGean Chemical Co.
McKinney Manufacturing Co.
Meaker Co.
Mechanical Plating Co.
J. E. Mergott Co.
Metal Finishers, Inc.
Metal Industry Publishing Co.
Metal Mouldings Corp.
Metal Process Corp.
Michigan Bumper Corp.
Michigan Chrome & Chemical Co.
J. C. Miller
Minneapolis-Honeywell Regulator Co.
Mitchell-Bradford Chemical Co.
Motor Products Corp.
Munning & Munning, Inc.
Mutual Chemical Co. of America
George L. Nankervis Co.
Nash Kelvinator Corp.
National Aniline Div., Allied Chemical & Dye Corp.
National Brass Co.
National Cash Register Co.
National Screw & Manufacturing Co.
Nelson & Long
New Jersey Zinc Co.
G. J. Nickolas & Co.
Noblitt-Sparks Industries, Inc.
Northwest Chemical Co.
Oakite Products, Inc.
Oneida, Ltd.
Packard Motor Car Co.
Pape Electro Plating, Inc.
Parker Rust Proof Co.
Parker-Wolverine Div., The Udylite Corp.
Parts Manufacturing Co.
Pennsylvania Salt Manufacturing Co.
Perma-Line Rubber Products Corp.
Plating Products Co.
Platers Supply Co.
Precision Castings Co.
Proctor Electric Co.
R. C. A. Victor Div., Radio Corp. of America
Richard I. Reid
Reynolds-Robson Supply Co.
Roberts Rouge Co.
Royal Plating & Polishing Co
St. Louis Metalcrafts, Inc.
Scoville Manufacturing Co.
J. P. Seeburg Corp.
Speakman Co.
Spectranome Plating Co.
Standard Plating Works
Standard Steel Spring Co.
Stanley Works
Frederic B. Stevens, Inc.
Sturgis Products Co.
George A. Stutz Manufacturing Co.
Sunnen Products Co.
Superior Plating & Rustproofing Co.
Superior Steel Corp.
Surety Electroplating Co.
Talon, Inc.
Thomas Brothers, Inc.
Thomas Steel Co.
Tri-Boro Electroplating Co.
Udylite Corp.
United Chromium, Inc.
United Platers, Inc.
U. S. Time Corp.
United States Spring & Bumper Co.
Universal Button Fastening & Button Co.
Van Der Horst Corp. of America
Wagner Brothers
A. T. Wagner Co.
R. Wallace & Sons Manufacturing Co.
Waterbury Buckle Co.
Waterbury Plating Co.
W. W. Wells, Ltd.
Western Electric Co.
Westinghouse Electric & Mfg. Co.
Wheeler Industries, Inc.
Whitney Blake Co.
Winters & Crampton Corp.
Wolverine Brass Works
Wyandotte Chemicals Corp.
Youngstown Sheet & Tube Co.

Research Committee

(*Continued from Page 203*)

ing Room Wastes" has been established at Yale University under PROF. F. C. DODGE, Chairman of the Department of Chemical Engineering, as Project Director.

The Research Committee plans to have an exhibit at the Metal Finishing Exposition in connection with the 1947 June Convention.

A. S. T. M. Committee B-8 Meeting

Meetings of the American Society for Testing Materials are scheduled for the week of February 24, at the Hotel Benjamin Franklin, Philadelphia, Pa. The scheduled meetings for Committee B-8 on Electrodeposited Coatings are as follows:

Thursday, February 27:

Sub-Committee I—9:00 to 10:30 A. M.

Sub-Committee II—10:30 A. M. to 12 Noon

Sub-Committee III—1:00 P. M. to 3:00 P. M

Sub-Committee IV—3:00 P. M. to 5:00 P. M.

Friday, February 28:

Committee B-8—9:00 A. M. to 12 Noon

These meetings are held in connection with the 1947 Committee Week and Spring Meeting during February 24–28. One of the features of the meeting is a "Symposium on Paint and Paint Materials" which is slated for presentation during the morning and afternoon of Tuesday, February 25. Committee D-1 on Paint, Varnish, Lacquer and Related Products has accepted the task of planning the symposium and soliciting the papers. According to Carlton H. Rose, Chairman of the Symposium Committee, it is planned to divide the symposium into three parts, one dealing with the application of statistical analysis and quality control methods, one pertaining to physical properties of films, and one on the evaluation of paint materials.

The Benjamin Franklin Hotel, 9th and Chestnut Streets, is the official headquarters hotel for the week.

1947 Milan International Fair

The *Fiera Di Milano* of Milan, Italy, has entrusted *SIFEM, Servizi Internazionali Fiere Esposisioni Mostre*, to organize the joint participation of exhibitors from the United States. Inasmuch as the *1947 International Sample Fair* is scheduled for April 12 to April 25, there is very little time to inform American interests of this opportunity—the opportunity to implement the efforts of The United Nations, and the opportunity to effectively bid for the European markets which in the long run will be vital to our industry. It is vastly important in many ways to develop our foreign trade. The effectiveness and soundness of manner with which this is done will largely determine our future as well as the future of The United Nations because man for centuries has developed his society through trade.

The *Hon. Gasparotto*, President of the Fair, states that the experimental showing in September, 1946, was so successful that exhibitors who participated had already by last November advanced some 75,000,000 L. for the rental of space this coming April. New construction has been planned for an amount over 350,000,000 L. which covers not only new pavilions already built, but, among others, even a new central semicircular pavilion covering some 10,000 square meters. Another measure of last September's success is evidenced in the record single day attendance which was estimated at 200,000. Inasmuch as there had been no organization of participation by the United States and due to the many and manifest difficulties then existent in Europe, September's performance bodes well for the attainment of their goal.

The Fiera Di Milano, through SIFEM, its agent, has authorized *Mr. John B. Erskine* of Chicago to handle all its affairs and interests in this country and in some cases in Canada. Mr. Erskine is temporaily located in No. 2251, 135 South LaSalle Street, Chicago, telephone Central 4606.

Tips on Latin-American Trade

"Do's" and "Don'ts" for U. S. manufacturers interested in entering and competing successfully in the fertile Latin American market has been outlined by *David Lindquist* in *Exporter's Primers*, an article which appeared in the *Inter-American* Magazine. Some of the hints are:

Don't

1. Don't fail to learn Spanish and Portuguese.

2. Don't hire an interpreter unless absolutely necessary. If you must—make sure he knows the technicalities of your business and product.

3. Don't tie in with an export agent who handles too many lines, or whose lines widely differ from yours.

4. Don't be impressed with an export agent just because he has many offices throughout Latin America. Many offices mean many lines—but not necessarily a good selling job for YOU.

5. Don't give representation of your line to a Latin American citizen you haven't investigated. He may need business because he's disliked by his compatriots. In any event, his political background should also be investigated, particularly if the city, state or federal governments are your potential customers.

6. Don't go to Latin America yourself unless you like the people and the places or think you will like them. Latinos are sensitive to American "hurry-up" because of a desire to get back home.

7. Don't hire a European to push your North American product.

8. Don't fail to educate your customers in the correct use of your product. The manufacturer is blamed for poor results when a product is used for purposes for which it was never intended.

9. Don't permit Latino importers to sell your products at inflationary prices. This can cause permanent damage to the goodwill you need.

Do

1. Do set up your own export department and hire an experienced technician; send him to Latin America to become acquainted with present prospects and find new ones.

2. Do pay such a man well and guarantee his expenses. Investigate him thoroughly first and then place complete trust in him.

3. Do work through an American export house when your product fits in well with those already carried by the firm, and so take advantage of a tested prospect list.

4. Do investigate your export-agent-candidate thoroughly. Many of those set up in American port cities ruthlessly exploit both Latin American buyers and U. S. manufacturers.

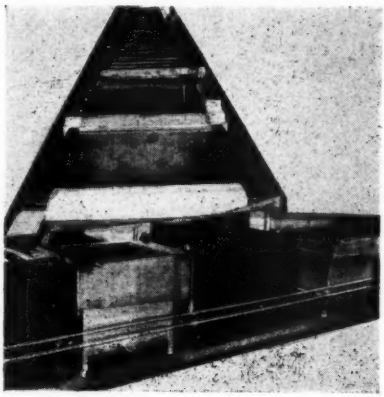
5. Do consider forming an export organization with other non-competitive manufacturers if you cannot afford a full fledged department of your own. Your firm will then sell to the export company which charges a small commission to pay expenses. Representatives are trained to handle the business of all, and each member firm takes an equal part in the management of the export company.

6. Do grant exclusive representation to another manufacturer who already maintains an active export organization for a product or products which complement yours. This means that the manufacturer's representative will frequently be able to pull in more business on his own product because he can sell your supplementary or complementary products with his and vice versa.

7. Do give thought to credit extension. Europeans in Latin America are said to be much more generous in this respect than North Americans.

8. Do consider the rising standards of living in Latin American countries and what an infant export business will mean to you in the long run—if properly inaugurated now.

9. Do keep the friendship and respect of Latinos with whom you do business. This is good public relations—and we have need of much more of it with our Latin American neighbors.



Designed for Heavy Duty

THIS complete plating cycle, Storts designed and Stortswelded throughout, was made for continuous operation under extremely severe corrosive conditions. It illustrates Storts facilities for fabricating all of your plating tank needs, from single tank replacements to complete installations, with all piping, coils, exhaust ducts and other accessories, ready to go to work. Every part of every unit is expertly designed to give long years of good service. Investigate when you are next in need of tanks and see "what Storts can do for you."

STORTS WELDING COMPANY

42 Stone Street Meriden, Conn.

NEW HAVEN BRANCH

Over seventy members and guests were welcomed by PRESIDENT JOSEPH M. COOKE to the Open Meeting and Platers' Clinic on November 12 in the Hotel Taft.

HENRY B. SMITH, Chief Chemist of R. Wallace & Sons Manufacturing Company, introduced the following panel of experts: JOSEPH T. SULLIVAN, MacDermid, Inc. (Technical Chairman); GEORGE B. HOGABOOM, Consultant; HENRY L. KELLNER, Lea Manufacturing Company; ARTHUR W. LOGOZZO, Nutmeg Chrome Corporation; WALTER R. MEYER, Enthone, Inc.; I. LAIRD NEWELL, Henry Souther Engineering Company; and HENRY STROW, MacDermid, Inc.

The panel answered questions for over two hours and gave the audience a broad education. It was the general consensus that more meetings of this type should be held.

The meeting adjourned for refreshments, and the discussion of plating problems continued unofficially until 12 P. M.

B. J. GAFFNEY,
Secretary-Treasurer.

●

COLUMBUS BRANCH

The November meeting of the Columbus Branch on the 26th, a joint meeting with the other technical organizations comprising the Columbus Technical Council, consisted of a dinner at the Seneca Hotel followed by a semi-technical talk on "Microwaves in Communication" by DR. J. O. PERRINE, Assistant Vice-President of A. T. & T. A considerable array of demonstration equipment was used to illustrate various phases of the talk.

A short executive meeting of A. E. S. Branch officials was held after the C. T. C. meeting had adjourned.

The December Branch meeting was held in the Battelle Institute Auditorium on December 6 with fourteen members and four guests in attendance. Following a lengthy business session, the present technical reporter reviewed the results of the past year's research on the chromium plating process. The meeting was closed after a discussion of the proposed "Ohio Chemists Registration Act" which was carried over from the business session.

CLOYD A. SNAVELY,
Second Vice-President.

●

MONTREAL BRANCH

The Educational Session at the monthly meeting on December 3 consisted of an open forum discussion of Research Project No. 5 led by LIBRARIAN J. T. REISENBURG. Interest was being expressed especially in contaminated rinse waters and in contamination of solutions by rinse waters.

PRESIDENT E. R. DAVIDSON then read a very interesting paper on the same subject by MR. A. C. WEST of Canadian Hanson-Van Winkle Company, and one on "Temperature Control" by MR. F. E. P. GRIGGS of the same company.

There was one resignation, and one application was accepted.

WILLIAM GLOVER,
Secretary-Treasurer.

●

SYRACUSE BRANCH

The meeting on November 29 held in Bowne Hall, Syracuse University, had an attendance of twenty-two.

PRESIDENT NEIL MAFFEI appointed the following Branch Research Committee for 1946–47: MATHIAS P. BOLAND, Chairman;

F. F. DUVALL and R. J. COLVIN. Methods of soliciting contributions to the Research Fund were discussed and referred to this committee.

The Delegates were instructed to vote affirmatively on the motion to suspend the existing Constitution for the duration of the meeting for constitutional revision.

Two new members were elected. There was one resignation.

The speaker of the evening was our Librarian, MR. PAUL SWARTZ of the L. C. Smith and Corona Typewriters, Inc. His subject was "The Effects of Heat Treatment on Tumble Deburring". Mr. Swartz illustrated with samples and photographs the effect of cyanide hardening on tumble deburring of small parts. The novel method led to a considerable number of questions and comments.

A discussion followed of the queer behavior of a chromium plating tank which had been contaminated during spray painting of the plating room. After removal of floating paint by skimming, the tank plated satisfactorily on racked parts but not on parts in baskets. No satisfactory answer, other than discarding the solution, was presented.

N. F. MURPHY, *Secretary.*

●

TOLEDO BRANCH

The Regular Meeting on November 7 was opened by PRESIDENT GEIGER with twenty-five members present.

The highlight of the evening was a talk on "Purification of Plating Solutions by Carbon Treatment" by MR. W. A. HELBIG of Darco Corporation, New York City.

G. BERGEMAN, *Secretary.*

●

SOUTHEASTERN BRANCH

The Southeastern Branch met in Atlanta at the Robert Fulton Hotel on Friday night December 6, PRESIDENT R. E. NORMAN presiding.

CLEM HORNER introduced MR. W. L. PINNER, A. E. S. Past-President, who expressed his pleasure in being present and able to award a Permanent Charter to the first Branch of the Society in the deep South.

Mr. Pinner, who became a member in 1932 and President fourteen years later, brought out that the Society is unique in that a large part of the membership consists of practical platers who bring with them wide experience for which there is no substitute. The chemists, chemical engineers and physicists who belong have wrought scientific advances in the art. In the past eight years, the Society has made striking advances. Today it boasts nearly 5,000 members and operates on a budget, including research activities, of $80,000 a year—every member receiving about $18.00 worth of education and service. Large concerns now recognize the worth of the Society. Two years ago, its publications were found in only one library in the country—today there is a lack of back numbers to place in libraries. Recently the Electrodepositors' Technical Society of England expressed interest in a merger with the A. E. S. and plans are now under discussion. THE MONTHLY REVIEW now contains adequate material of educational value.

Mr. Pinner offered several suggestions for the meetings of the Southeastern Branch, especially that minimum time be spent on business matters and maximum time on matters of educational value. Members will continue to attend meetings as long as they are interesting.

At this point, Mr. Pinner presented the A. E. S. Charter with the best wishes of the Executive Board and himself. President Norman accepted the Charter with heartfelt thanks of the entire membership and thanked Mr. Pinner for coming to Atlanta for the occasion.

WILLIAM T. WEYMOUTH read a congratulatory telegram from A. E. S. SECOND VICE-PRESIDENT S. S. JOHNSTON. A. E. S. FIRST VICE-PRESIDENT KENNETH HUSTON advised in a letter that he would be in Atlanta on February 13 and offered to speak at the meeting that night. The offer was gratefully accepted.

At this point, Mr. Pinner discussed "High Speed Nickel Plating", and illustrated his subject with slides.

WILLIAM T. WEYMOUTH,
Secretary.

LOS ANGELES BRANCH

About fifty persons attended the dinner which preceded the Regular Meeting on December 9. Among the sixty present at the meeting were C. G. SPENCE who had recovered completely from his airplane injuries, C. C. MCLAREN with a black shield over his damaged eye, FRANK BUNKER back from a well-earned vacation, CARL KLEINFELTER on terminal leave from the Army, and JULIUS J. WITTE, a member of the Chicago Branch since 1912, who entertained the group with a humorous speech.

PAUL KOECKRITZ of Los Angeles Parkerizing Company described in considerable detail the nature and properties of a number of processes and coatings put out by the Parker Rust Proof Company and referred to U. S. Army Specification 57-0-2 and U. S. Navy Specification M-364.

The Question Box period brought forth the following:

Q. 1: How can the trivalent chromium content in a decorative chromium solution be reduced?—A. (by COFFIN): My experience with the porous cup method has led me to conclude that it is easier to prevent its formation by proper operation than to remove it. It is more economical to discard a highly contaminated solution than to correct it.

Q. 2: About four pounds of sodium sulfide was accidentally introduced in a copper solution containing 3.3 oz/gal copper, 5.0 oz/gal Rochelle salts, 6.9 oz/gal carbonate, 0.75 oz/gal free cyanide and 3.0 oz/gal caustic soda. Could it have caused pits similar to nickel pits and roughness? How can it be removed?—A. (by ELDRED): 3 oz/gal caustic soda is too high, 0.5–1.0 should be sufficient to obtain the desired *p*H of 12.2–12.5.—A. (by WELLS): The free cyanide should be raised to as high as 1.5 oz/gal to yield a softer deposit if the temperature is kept at 140° F.—A. (by COFFIN): The sodium sulfide will have precipitated copper sulfide which may have caused the roughness and should be removed by filtration.

Q. 3: How can zinc be removed from a du Pont copper solution?—A. (by ELDRED): Allow the free cyanide content to run down, dummy at the normal plating current density until the brass color disappears, and restore the free cyanide content. Prevention is easier than the cure.

Q. 4: Which is the best method to clean die castings for barrel plating? What bright dip is suggested? Which is the best strip for cadmium on rejected die castings?—A. (by PEARSON): We obtain best results by vapor degreasing followed by non-electrolytic cleaning in a mild alkali cleaner. While a weak sulfuric acid dip is often recommended, we prefer a dip in strong sodium cyanide solution which eliminates blistering. Rejects are stripped in the usual ammonium nitrate solution without difficulty.

Q. 5: How can zinc die castings be stripped from copper-nickel plate for replating without blistering?—A. (by ELDRED): Strip chromium in hot caustic soda solution with reversed current, or strip both chromium and nickel in cold 55° Baumé sulfuric acid with reversed current, then strip the copper in liver of sulfur solution, rinse, dip in sodium cyanide solution and repeat if necessary.—A. (WOOLEY): Chromium and copper may be stripped in Unichrome Strip No. 81, but not nickel or zinc. The zinc die casting protects itself with an insulating film of zinc pyrophosphate which readily dissolves in the acid dip of the regular plating cycle.

Q. 6: How does the L. P. W. Sulfometer for measuring sulfate content of chromium bath, mentioned in *Modern Electroplating*, work?—A.: In principle, this instrument consists of an ammeter and voltmeter connected to a small cell with a 4–5 v source of dc, rheostat, lead anodes and brass cathode. With the solution to be tested in the cell, the voltage is raised slowly until there is a sudden increase in voltage and deposition of chromium. The current density at which this occurs is noted and the sulfate content estimated from current-voltage reference curves plotted for solutions of known composition. Actually, the ammeter of the instrument is calibrated to read the sulfate ratio directly.

Q. 7: Does bare aluminum tend to decompose the vapor degreasing solvent?—A. (by HOLMAN): No, but finely divided

aluminum, iron and copper found in smears of buffing, polishing, deburring, routing and deep-drawing compounds as well as pigments in aluminum and bronze paints and gilt lacquers, do initiate decomposition of improperly inhibited trichlorethylene and cause formation of hydrochloric acid.

The Past Presidents Committee had appointed D. N. Eldred as Chairman of the Annual Educational Session and Banquet Committee. He, in turn, appointed Earl Coffin and John Marigold Assistant Chairmen. President Eldred also announced his appointment of Ray Bray to head the Research Finance Committee.

Five newly elected members were initiated. There was one in-transfer from Detroit Branch, seven suspensions and one resignation.

In response to A. E. S. Educational Chairman Ken Huston's appeal, the Secretary requested all members to donate all back issues of The Monthly Review and the *Proceedings*. President Eldred and the Secretary reviewed Constitution Revision Committee Chairman W. L. Pinner's letter. The Branch voted to instruct its 1947 Convention Delegates to vote favorably on the motion to suspend the Constitution during the deliberations.

E. R. Holman,
Secretary-Treasurer.

●

PROVIDENCE-ATTLEBORO BRANCH

The December meeting was held at the Highland Country Club in Attleboro, Mass., and took the form of an "Early Winter Frolic". The committee in charge, consisting of Jack Henry, Pete Lonsbury and Woodie Woodwell, deserves much credit for arranging one of the most brilliant events in the history of the Branch. The evening started off with a sumptuous turkey dinner with all the fixings. This was followed by some well-chosen and excellently delivered remarks by Mr. George B. Hogaboom on the good of the Society and what fine things we may expect from membership therein in the future. Top flight entertainment rounded out the evening. Members of Hartford, Boston, Bridgeport and New York Branches were in attendance.

The 1946–1947 season opened in Septemwith an informative and interesting talk by Ed Rinker of A. Robinson & Son, New York City, entitled "Heavy Metal Deposits", as usual delivered in this speaker's most pleasing manner.

Dr. Walter R. Meyer was the speaker at our October session and had for his topic, "Metal Preparation". This talk was illustrated, and was considered unusually helpful by those in attendance.

"Rectifiers vs M-G Sets" was the title of a talk before this branch at our November meeting. It was given by Mr. Doss of Cleveland, Ohio, representing Electric Products Corporation of that city. Mr. Doss handled this highly controversial subject in a manner most fair and pleased his hearers greatly.

Charles C. Chace,
Secretary-Treasurer.

●

LANCASTER BRANCH

The Lancaster Branch held its first Ladies' Night on December 13 at the Conewago Inn, seven miles north of York, Pa. There were forty members and guests present. The Committee Chairman Harry Hovis outlined the evening's program and expressed the appreciation of the Branch to those who had contributed prizes and money. President Harold Kilheffer then welcomed the ladies and expressed his wish that this affair will become bigger and better each year.

After a delicious turkey dinner, we were led in singing by Christ Brubaker and Norman Gebert. We were then entertained with three short movies: a travel picture, a musical picture and a Christmas story. The tables were then cleared for Bingo. A prize was given to each winner, and at various stages of the game, numbers were drawn for the door prizes. Each lady was also presented with a pair of nylons and a compact. The festivities ended at Midnight and all were unanimous that the party had been a grand success.

H. Clay Brubaker, *Secretary.*

●

ST. JOSEPH VALLEY BRANCH

The regular monthly meeting on Novem-

ber 6 in the Hotel Elkhart, Elkhart, Ind., was attended by forty members and guests at the dinner and sixty-three at the technical session.

Thirteen applicants were accepted into membership. Three new applications were received.

It was announced that T. SHAFER was attending the meetings of the Safety Codes Committee and would keep the Branch informed of the progress being made.

PRESIDENT HARLAN introduced MR. G. STUART KRENTEL of Anodizing Incorporated, Chicago, who first invited the Branch to attend a conference, sponsored by the Chicago Branch, on "Nickel Plating of Zinc Base Die Castings" to be held in Chicago on January 18. He then discussed types of cleaners including electrocleaners, soaking cleaners containing wetting agents to assist rinsing, and the methods of using them.

RAYMOND A. FRIEND, *Secretary.*

●

TWIN CITY BRANCH

Ten new members were introduced by Membership Chairman AL. LEONARD at the December 2 meeting in the Covered Wagon, Minneapolis, Minn.

The Secretary announced that one member, CLINT WALMAN of National Plating Company, will be in the hospital for about eight more months and asked that the members of the Branch visit him when possible.

The meeting concluded with musical entertainment, and movies of outdoor life made by the University of Minnesota.

ROBERT L. BUCKLEY,
Secretary-Treasurer.

●

SPRINGFIELD BRANCH

The following new Officers were installed during the meeting in Hotel Charles on December 16.

President—CHESTER KLIMEK
First Vice-President—JOHN COSTIGAN
Second Vice-President—ERNEST COUTURE
Secretary-Treasurer—LAURENCE FOUNTAIN
Board of Managers—FRANK SCHULTZ (Chairman), ARTHUR COPP and FRANCIS O'DONNELL
Librarians Committee—T. J. MURRAY (Chairman), ARTHUR ZAVARELLA and JOHN HORRIGAN
Research Committee — FRANK CLARK (Chairman)
Review Collection—JOHN COSTIGAN

Plans were laid for a joint meeting with the American Society for Metals on January 20.

LAURENCE R. FOUNTAIN,
Secretary-Treasurer.

●

SYDNEY BRANCH

The following officers have been elected for the year commencing January, 1947:

President—E. J. WRIGHT
First Vice-President—F. J. HEARD
Second Vice-President—W. PATERSON
Secretary-Treasurer—J. R. GODFREY
Board of Managers—T. H. WILSON, B. W. ARMSTRONG and F. R. BELLENGER
Educational Committee—W. H. MILLWARD, G. R. RICHARDSON, R. A. VALLOCK and J. L. BURBURY

J. R. GODFREY,
Secretary-Treasurer.

●

ROCHESTER BRANCH

At the monthly meeting on December 20, LIBRARIAN JOSEPH HULL introduced MR. WILLIAM G. KULESZ, Buffalo District Manager of the Mine Safety Appliance Company, who discussed hazards encountered in industrial processes and necessary safeguards. Various types of protective apparel, such as goggles, face shields, dust and gas masks, and gloves were displayed, and their proper applications described. The use of hand creams, aprons, boots and caps were mentioned.

A moving picture entitled *The Air We Breathe* was shown after which followed an interesting discussion.

ROBERT L. FLINT, *Secretary.*

●

DETROIT BRANCH

The Annual Educational Session and Party were held in Hotel Statler on December 14. After a few words of welcome, PRESIDENT WRIGHT WILSON introduced LIBRARIAN GEORGE PILLSBURY, who turned the chair over to MR. CARL HUESSNER, presiding chairman at the Educational Session.

Mr. J. C. Fox, Chief Metallurgist of the Doehler-Jarvis Corporation, spoke on the "Manufacture of Quality Zinc Base Die Castings". A historical review of the process was given and great emphasis placed on the metallurgy of the zinc base die casting. He showed the composition of a number of the important alloys and pointed out the effects of impurities and alloying constituents, particularly on the physical characteristics of the die casting. The manufacturing process was covered in good detail, and casting conditions were mentioned which would minimize the subsequent polishing where the final finish was to be plated. Mr. Fox's paper was well presented and furnished an excellent background for the papers to follow.

Mr. Cleveland Nixon, General Motors Corporation, Ternstedt Division, spoke on "Plating of Die Castings—including Buffing, Cleaning, Plating and Stripping". He pointed out the usual defects associated with zinc base die castings and how they affect the final product. Some defects can be taken care of during the polishing operation, others require scraping of the casting. A typical cycle including belt polishing, degreasing, and cleaning, copper, nickel and chromium plating was illustrated. Mr. Nixon's presentation was very complete and enlightening to all of us.

Following Mr. Nixon was Mr. A. E. Anderson of the New Jersey Zinc Company. His paper was entitled "Testing of Plating on Die Castings" and covered in particular detail a recent survey which his company had made of plated zinc die cast parts on 1941 automobiles. He correlated the present condition of the die castings, including blistering and other surface defects, with thickness and adhesion of deposits. The general conclusions were that parts plated with adequate thickness resisted corrosion and blistering much more satisfactorily than those with thinner deposits, and that the better the adhesion, the higher the corrosion resistance.

The attendance at this meeting was excellent, over two hundred members and guests which was indicative of great interest and desire for more knowledge in the handling of zinc base die castings, one of the most popular engineering materials of today.

After an intermission of several hours, a very delicious and satisfying banquet was served in the three adjoining ballrooms of the Hotel Statler, followed by an excellent entertainment program and dancing, which was greatly enjoyed by all present.

Those in attendance spoke highly of the excellent job done by Mr. Pillsbury in arranging an instructive and enjoyable educational session, and by Mr. George Nankervis for planning the very successful banquet and entertainment program.

R. H. Dudley,
Publicity Chairman.

●

CHICAGO BRANCH

The December meeting was held on Friday the 13th in the Atlantic Hotel. The members of the Branch indicated their usual intelligence by defying superstition and turning out in force. A. E. S. President Frank Savage was in the audience and discussed the problems presented by the prospective changes entailed in a new constitution for the Society.

Mr. E. F. Hahnfeldt of the Mine Safety Appliances Company did an excellent job on almost a moment's notice in presenting the factors involved in manufacturing appliances designed to prevent industrial pulmonary and respiratory hazards. He also touched on the use of protective creams to reduce dermatitis.

He supplemented his remarks with a sound movie entitled *The Air We Breathe* which gave the attending members an excellent idea of the commonplace hazards to which the metal finisher is subjected daily.

The question box was well subscribed to.

G. Stuart Krentel,
Review Correspondent.

●

PITTSBURGH BRANCH

The December 19 meeting was held in the Avalon Room of the Keystone Hotel. It was preceded, as usual, by an informal dinner. During the short introductory business meeting, two applications were voted upon favorably, and three newly received

were referred to the Board of Managers.

A. E. S. SECOND VICE-PRESIDENT S. S. JOHNSTON discussed the campaign to secure back issues of THE MONTHLY REVIEW and *Proceedings* for libraries. He also urged the members to return the information cards sent out by Jenkintown.

PRESIDENT KELLER announced the appointment of the following committee chairmen:

Research Committee—GLADE BOWMAN
Exhibits Committee—M. A. PETERSON
Membership Committee—G. A. JERSEY
Back Issues Committee—H. F. SAYLOR

R. A. DIMON then resumed the series of talks on the general subject, "Fundamental Principles Underlying Electroplating", with discussions of "Electrode Reactions" and "The Electrolyte".

G. A. JERSEY of Air Tool Parts Company showed an exhibit of some interesting applications of chromium plating.

WILLIAM V. HENNESSY then introduced as the principal speaker a member of our own Branch, MR. KENNETH TATOR, President of Industrial Lining Engineers, Inc. Mr. Tator spoke on the subject, "The Newer Rubbers and Plastics as Electroplating Maintenance Materials" and exhibited a wide acquaintanceship with this subject. This talk was followed by an interesting Question-and-Answer period, during which the members questioned the speaker in regard to their particular problems.

RICHARD A. DIMON,
Secretary-Treasurer.

●

PITTSBURGH BRANCH

The November meeting was held on the 21st in the Bureau of Mines Auditorium. PRESIDENT KELLER presided, and in the absence of R. A. DIMON, R. J. GOLDBACH acted as secretary. Twelve applications for membership were favorably acted upon, and two new applications for membership were received.

The Branch was fortunate in having present at this meeting three members of the National Executive Board, FIRST VICE-PRESIDENT HUSTON, SECOND VICE-PRESIDENT JOHNSTON and EXECUTIVE SECRETARY GRAHAM.

After a short business meeting, LIBRARIAN HENNESSY introduced the principal speaker, MR. KENNETH M. HUSTON, and his associate, MR. HARRY ESPE of the Rustless Iron and Steel Division of American Rolling Mill Company, Baltimore, Md. Mr Huston read a paper prepared by MR. JOHN KREML of his company on the electropolishing methods and practices used industrially up to the present time. He then answered numerous questions while Mr. Espe polished samples in a portable unit.

RICHARD A. DIMON,
Secretary-Treasurer.

●

NEWARK BRANCH

There were two elections to membership, one new application and one out-transfer at the regular meeting on December 6.

HORACE SMITH, our genial Chairman of the Christmas Party, again announced the big event on December 14.

LIBRARIAN ZACHARY IRENAS introduced MR. E. J. ROEHL of the International Nickel Company whose subject was "Heavy Nickel Plating". Mr. Roehl described the mechanical and physical properties of nickel and its behavior during corrosion. The application of nickel deposits of 0.005 to ½-inch thickness was illustrated with slides. The talk was well received by the members.

In the discussion that followed, some of the questions were:

Q. 1: How can you strip nickel from steel?—A. In concentrated sulfuric acid with reverse current at 2 to 5 volts.

Q. 2: How do you plate stainless steel?—A. Start in a bath containing 36 g/l hydrochloric acid and 240 g/l nickel chloride at 20 asf using first reverse and then direct current.

Q. 3: At what temperature does plated nickel change from hard to soft?—A. At about 1400° F.

GEORGE REUTER,
Assistant Secretary.

●

BRIDGEPORT BRANCH

PRESIDENT H. M. GOLDMAN opened the regular meeting on December 6 with forty members and guests present.

The Branch Research Committee reported two new sustaining members—*The Roberts Rouge Company*, Stratford, Conn.,

and *The Electrolux Corporation*, Old Greenwich, Conn.

The Membership Committee reported one new application. Four men were elected to membership.

The Secretary was ordered to send out copies of First Vice-President K. M. Huston's appeal to all the members for back issues of THE MONTHLY REVIEW and the new A. E. A. Constitution drafted by W. L. Pinner and his committee.

PHILIP A. WILLET, who has given many years of service to the Bridgeport Branch, was unanimously elected as an Honorary Member of the Branch.

A motion was made and passed to hold another "Old Timers' Night". The President appointed WILLIAM A. EHRENCRONA Chairman and he is to appoint his own committee.

FRANK ROCK spoke on the possibility of having high school students give papers on electroplating and finishing with cash prizes awarded for the best papers.

LIBRARIAN CARL SCHAEFER then conducted Technical Session Period. He brought up a number of electroplating and finishing problems which were discussed from the floor.

JOSEPH G. STERLING,
Secretary-Treasurer.

DAYTON BRANCH MEMBER WINS TOULMIN TROPHY

The highlight of the November meeting of the Dayton Branch of the American Electroplaters' Society was the presentation of the Toulmin Trophy to Mr. L. A. Critchfield of the Dayton Branch for his paper, "Plating Rack Coatings".

The Toulmin Trophy is presented each year to the member of the Columbus, Cincinnati, Indianapolis, or Dayton Branches who has presented the best paper given at any of the Branches' meetings.

The papers are judged by the three immediate A. E. S. Past Presidents.

Mr. Critchfield's paper may be found in the February, 1946 issue of THE MONTHLY REVIEW.

BY-LAW AMENDMENTS

At the annual business meeting held in Pittsburgh, Penna., the delegates passed the following amendments to the By-Laws. Branch Secretaries will be particularly interested in the partial relief afforded.

PART I, ARTICLE IV, Section 4(b), change to read: "Registration Fee: The registration fee of the Convention shall be determined by the Branch Society sponsoring the Convention subject to the approval of the Executive Board."

PART I, ARTICLE VI, Section 1, change to read: "Applications: Each Branch Society shall keep a record of the name of each applicant for membership. No applicant shall be elected to membership until his application has been acted upon by the Board of Managers."

PART II, ARTICLE II, Section 4, second and third sentences to read: "He shall keep a record of the names of all applicants for membership. He shall send a corrected list of the membership of the Branch Society to the Executive Secretary at least once a year, and shall forward a list of all changes and additions each month."

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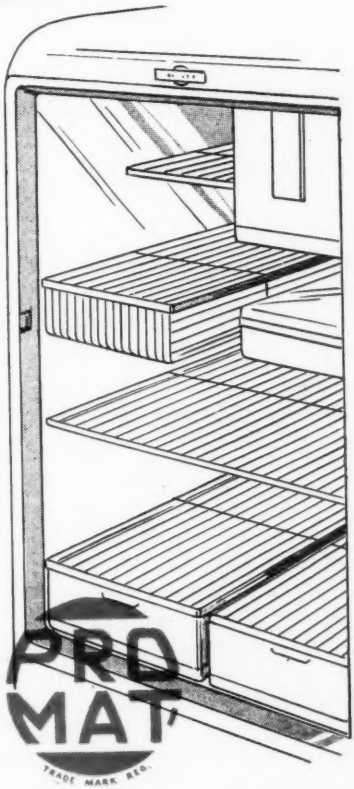

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By GEORGE B. HOGABOOM

Consultant, New Britian, Conn.

No. 2,411,327, November 19, 1946—Method of Electroplating and Treating Cutting Edge Tools and the Like—Axel E. Lundbye, assignor to Crowell-Collier Publishing Company.

7 Claims.

CLAIM 1. A method of plating and treating steel metal-cutting tools which comprises immersing a portion of a steel tool to be plated in an electrolytic bath containing between 30 and 80 ounces of chromium trioxide and sulphate in amount equal to one-hundredth of the weight of chromium trioxide per gallon of water, electrodepositing chromium on said article as a cathode at a current density between 0.7 and 3.5 amperes per square inch and at a bath temperature between about 100° F and 190° F for a period of about 1 to 2 minutes, removing the article from the bath, heating the tool in a heat-treatment bath to release hydrogen and decrease the brittleness of said tool, and cooling the article.

CLAIM 7. A method of plating and treating steel metal-cutting tools comprising immersing at least a portion of a steel tool in an aqueous electroplating bath containing about 0.33 ounce of sulphate and about 33 ounces of chromium trioxide per gallon, making the tool an anode in said bath for a few seconds to clean the tool anodically, electroplating the tool as a cathode at a current density between about 1½ to 3½ amperes per square inch and at a temperature of about 140° F for about 1 to 2 minutes, making the tool an anode for a few seconds to remove any beads formed on said tool, removing the tool from the bath, heating it in hot oil at about 350° F for about one hour, and cooling the tool.

No. 2,411,638, November 26, 1946—Insulating Shield for Electrolytic Tanks—S. B. Sanford and W. G. Nutzel, assignors to Otis Elevator Company.

In practicing electrolytic processes it is essential that there be no direct electrical contact between the electrodes. In some of these processes, e. g., anodizing of aluminum, a lead lined tank is employed and this lining is utilized as the cathode.

The object of the invention is to provide a durable insulating shield for use in an electrolytic processing tank, especially a metal lined tank in which the lining is utilized as an electrode.

2 Claims.

CLAIM 2. An insulating shield for an electrolytic processing tank having a metal lining serving as an electrode comprising a bottom portion for shielding the bottom of the tank, an upright portion for shielding the side and end walls of the tank, each portion comprising a plurality of spaced main members, each having a plurality of cross apertures equally spaced lengthwise

thereof, a plurality of cross members extending through said apertures, and a plurality of warp members between and parallel to said main members with which the cross members are interwoven, the main members of the upright portion extending vertically and having their apertures positioned therein so that the cross members of such portion form an upwardly extending spiral, and all of said members being bendable tubing of synthetic resin resistant to the chemical action of the electrolyte, all of said members of all sections being tubing of thermoplastic synthetic resin comprising polymers derived from vinylidene chloride.

No. 2,411,674, November 26, 1946—Art of Electrodeposition of Copper—Ernest D. Wilson, assignor to A. D. Little, Inc.

Substantially all commercial copper-plating processes involve the use of copper cyanide type baths or acid copper baths. Both types of bath, however, are subject to various disadvantages.

It is the object of the present invention to provide a copper-plating solution and method of plating such that the objectionable features of cyanide copper and acid copper baths are avoided.

Further objects of the invention are to provide an improved adhesion of plating to the base metal, as well as a lustrous finish to the surface of the electrodeposited plating so as to render it suitable for subsequent plating directly.

I form a bath with the following starting materials (commercial form):

	Pounds
Copper Sulfate ($CuSO_4.5H_2O$)	50
Ethylene Diamine (70%)	55
Lactic Acid (35%)	11
Boric Acid	16½
Water to make	100 gal.

32 Claims.

CLAIM 26. An aqueous electrolyte for use in electrodeposition of copper as a bright, smooth, firmly adherent deposit that consists essentially of a soluble copper salt, a sufficient quantity of an alkylene polyamine to form a complex with said salt and a compound selected from the group consisting of lactic, citric and tartaric acids and the alkali metal salts of such acids, in approximately one-half molecular proportion, and boric acid in approximately equal molecular proportion with reference to the copper salt.

No. 2,411,410, November 26, 1946—Electropolishing Stainless Steel—G. J. Beckwith, assignor to American Steel and Wire Company.

Bath Composition by Volume	*Per Cent*
Orthophosphoric Acid (85% grade)	80
Sulfuric Acid (60° Baume)	15
Pyridine	5
Current Density	.5 amp per sq in
Voltage	7 to 12 volt
Temperature	180° to 215° F
Time	2 to 4 minutes depending on the kind of stainless steel being treated.

3 Claims.

CLAIM 2. The process of producing highly polished surfaces on corrosion-resistant chromium steels, which consists in making the steel an anode in an aqueous electrolyte containing approximately 80% by volume of phosphoric acid of 85% grade, approximately 15% by volume of 60° Baumé sulfuric acid and about 5% by volume of a pyridene compound, providing suitable cathodes to assure uniform current flow from all parts of the steel anode, maintaining the electrolyte at temperatures between approximately 180°F to approximately 215°F, and passing a current through the resulting cell at a current density of substantially 5 amp per square inch of anode surface and a voltage from about 7 to about 12 volts.

No. 2,410,844, November 12, 1946—Metal Plating Process—F. K. Signaigo and W. J. Peppel, assignors to E. I. DuPont de-Nemours & Company.

CLAIM 1. A process for plating copper onto a ferrous metal surface which comprises contacting said surface with heated aqueous solution containing a soluble copper salt of a poly-hydroxythiol and an acid selected from the group consisting of sulfuric, hydrochloric and phosphoric acids.

No. 2,412,058, December 3, 1946—Electrolytic Polishing and Removing Excess Metal—I.. B. Pjeil, assignor to The International Nickel Company, Inc.

CLAIM 1. A process for removing about 0.001 to 0.005 inch of excess metal to dimensionally reduce to predetermined size and electropolish an oversize metal article characterized by intercrystalline oxidation at the surface thereof and made of composition from group consisting of nickel, nickel base containing chromium and stainless steels containing nickel and chromium, which comprises anodically polishing said article in an electrolyte comprising essentially phosphoric acid, sulfuric acid and water, the combined concentration of said acids being at least 50% by weight of said electrolyte, until about one-third of said excess metal is removed, abrading the anodically polished surface by impact of abrasive particles on said surface to decrease the anode activity of said surface in a succeeding anodic polishing treatments, repeating the said anodic polishing and abrasion treatments, and subjecting said articles to a final anodic polishing treatment whereby by said successive in-order step series of anodic polishing treatment and abrasion treatment and said anodic polishing treatment, said article is reduced to desired dimensions and electropolished.

(Note: There are 3 claims.)

No. 2,412,186, December 3, 1946—Method of Bright Polishing Stainless Steel Tubes—I. Whitehouse and Victor S. Chambers, assignors to Republic Steel Corporation.

CLAIM 1. The method of polishing which includes the steps of passing through the annular space between an elongated stainless steel tube and a cathode disposed axially therewithin a polishing electrolyte which fills said space and flows at a rate sufficient to dislodge gases from the inner surface of the tube, and passing through the flowing electrolyte and between the tube and the cathode a polishing current which is of substantially uniform density on every unit area of the inner surface of the tube.

(Note: There are 8 claims.)

No. 2,412,543, December 10, 1946—Coated Zinc Article and Method of Making Same—R. R. Tanner, assignor to Parker Rust Proof Company.

An article of manufacture having a zinc surface with a thin, adherent coating containing chromium and PO_4 and formed by drying on said surface an acidic solution consisting essentially of water, a compound containing hexavalent chromium, and a compound containing PO_4, the coating being substantially insoluble in water and containing some unreacted chemical.

No. 2,412,698, December 17, 1946—Chromium for Wear Resistance—H. van der Horst, assignor to Van der Horst Corporation.

CLAIM 11. A wearing member having a face of chromium to operate in frictional contact with another wearing member, there being in said face a multitude of depressions of various widths and of which the narrowest of the major number observable looking directly at the face at a magnification of 500 diameters is between about 0.00003 inch and 0.004 inch in width and the widest of said major number is between about 0.00003 inch and about 0.0125 inch in width.

(Note: There are 27 claims.)

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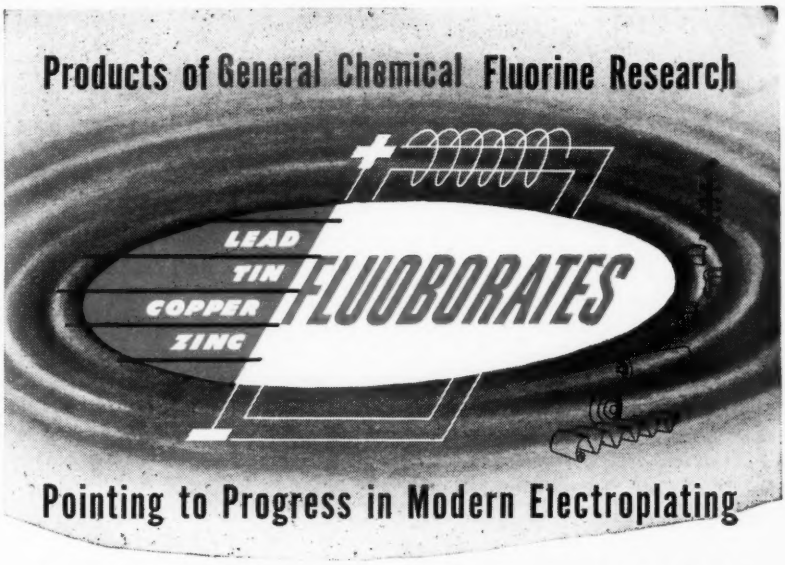

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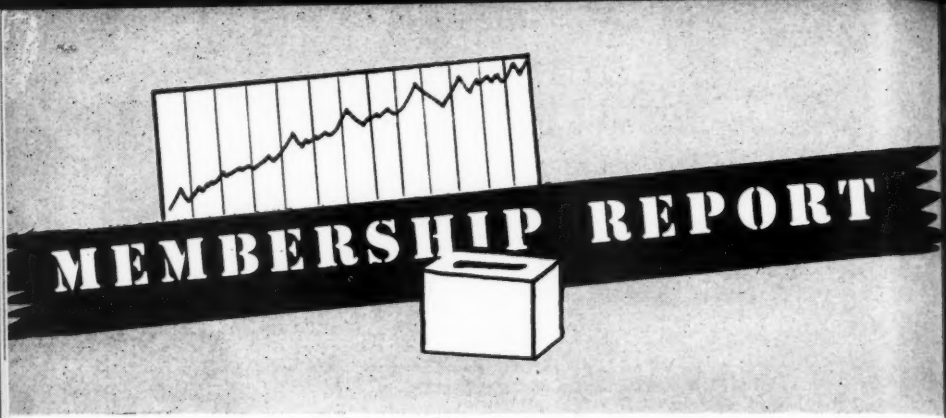

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NEW YORK	201	43	+36	+17.7
BRIDGEPORT	124	25	+20½	+16.5
PHILADELPHIA	170	30	+21½	+12.6
TORONTO	131	12	+ 7	+ 5.3
CHICAGO	359	29	+14½	+ 4.0
WATERBURY	128	9	+ 4	+ 3.1
LOS ANGELES	181	26	+ 4	+ 2.2
CLEVELAND	177	25	+ 3½	+ 2.0
HARTFORD	134	17	+ 2½	+ 1.9
BOSTON	168	4	+ 3	+ 1.8
NEWARK	243	13	− 3	− 1.2
DETROIT	440	29	−32	− 7.3
SECOND GROUP				
PITTSBURGH	97	23	+22	+22.7
INDIANAPOLIS	90	10	+12	+13.3
GRAND RAPIDS	116	14	+13	+11.2
ST. LOUIS	122	13	+12	+ 9.8
SPRINGFIELD	82	6	+ 5½	+ 6.7
BALTIMORE-WASH.	114	5	+ 3½	+ 3.1
BUFFALO	87	4	+ 2½	+ 2.9
PROV.-ATTLEBORO	122	16	+ 3½	+ 2.9
MILWAUKEE	120	12	+ 2	+ 1.7
ROCHESTER	97	1	....	....
DAYTON	87	7	− 1	− 1.1
NEW HAVEN	110	2	− 3½	− 3.2
SYDNEY	82	11	−14	−17.1
JACKSON-LANSING	85	1	−32½	−38.2
THIRD GROUP				
ST. JOSEPH VALLEY	60	17	+20	+33.3
ADELAIDE	37	12	+12	+32.5
TWIN CITY	72	24	+19½	+27.1
ROCKFORD	53	9	+ 9	+17.0
SYRACUSE	64	11	+ 7	+10.9
SAN FRANCISCO	64	13	+ 5	+ 7.8
MELBOURNE	59	..	+ 1	+ 1.7
COLUMBUS	34	5	....	....
LANCASTER	38	..	− 1	− 2.6
MONTREAL	61	6	− 2½	− 4.1
CINCINNATI	58	1	− 2½	− 4.3
TOLEDO	60	2	− 4	− 6.7
TOTAL A. E. S.	4,527	523	+207	+ 4.6

Membership Jan. 15, 1947. 4,734

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We are manufacturers of Fireplace Fixtures and need a trained man to take charge of our Brass Plating Department. Work about 20 men in plating, polishing and buffing. We plate only brass, on cast iron and steel. Expanding this department. Well established company. Located in Middle West. Please state experience and education.

Send replies to MR-12A, THE MONTHLY REVIEW, P. O. Box 168, JENKINTOWN, PA.

WE'RE LOOKING FOR A MAN WHO REALLY KNOWS ELECTROPLATING

We honestly believe this job presents more than an ordinary opportunity for a young sales minded engineer who knows electroplating. It's not an easy job—few good jobs are. But man, it's a swell chance. It pays a reasonable salary to begin with—ceiling unlimited. The job? To head up a new department in our sales organization specializing in material and equipment sales to the electroplating field. If that type of work appeals to you, and you have the necessary technical background, write us today.

Send replies to MR -2A, The Monthly Review, P. O. Pox 168, Jenkintown, Pa.

Metal Conditioning for Painting

A *Technical Service Data Sheet* on *Duridine* and *Granodine* may be had by writing to *American Chemical Paint Company*, Ambler, Pa.

Both processes produce uniform, finely textured phosphate coatings on iron and steel that will take and maintain a beautiful, enduring, lustrous paint finish. In addition, the Duridine chemical has a detergent action on dirt, oil and grease. Which to choose depends on production conditions. American Chemical Paint engineers will assist in making the right choice.

Variants for either spray or immersion treatments are available.

Job Shop Operations

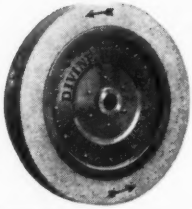
The *Masters' Electro-Plating Association*, 123 William Street, New York City 7, in its *Monthly Bulletin* for December advises that the rate of operation among its members during the month of December was 79% as compared to 82% during November and 70½% during December, 1945. This marks the first recession in many months. In normal times a recession in December occurs every year.

•

Nankervis Company Introduces Buffing Compound Applicator

A new *Buffing Compound Applicator* that has an intermittent feed control operating

For Precision Polishing



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Easy to Balance
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Tanks are supplied with or without exhaust ducts and fans as conditions or specifications indicate.

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at the rate of 14 strokes per minute, affording a feed ranging from 0.0015" to 0.015" per stroke is announced by the *George L. Nankervis Company*, 5442 Second Boulevard, Detroit 2, Mich.

The *Nankervis Applicator* can be mounted on any automatic machine (either right or left-hand) and can be adapted to everything from a simple to complex multiple-stage buffing operations . . . it is driven by a totally enclosed, geared-head motor . . . 110 volt, 220 or 440 volt motors are available. The quick action compound applicator clamp, with adjustable features to compensate for variable thicknesses and standard carrier, will accommodate any length compound stick up to four inches. Special carriers are available for wider cakes. The light weight of only twenty pounds permits adaptation to floating heads without disturbing the balance.

Users, it is stated, find that this automatic method of applying the compound as compared to hand feeding will effect savings upwards to 40% by saving in compound, improving the quality and uniformity of the work, and speeding up the job.

●

Wyandotte Chemicals Adds Two Ohio Representatives

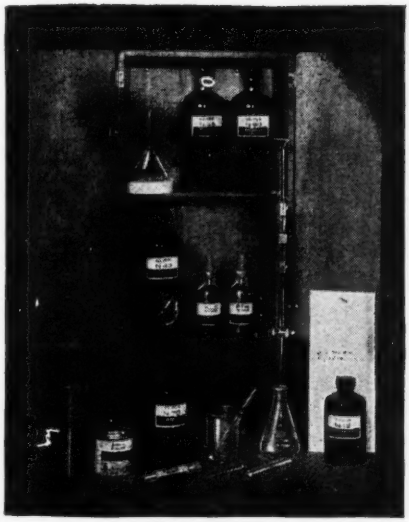
Charles N. Chalfont and *John E. McCarthy* are recent additions to the Industrial Department Service staff of *Wyandotte Chemicals Corporation*. Both attended practical training courses in several Wyandotte territories before being given their Ohio

assignments—Mr. Chalfont to Dayton and Mr. McCarthy to Columbus.

For thirteen years Mr. Chalfont was a member of the laboratory staff of Copperweld Steel Company, and for the past four years was the Detroit Service Representative of G. Whitfield Richards, manufacturer of cutting, drawing and grinding lubricants His chemical and metallurgical studies at Carnegie Tech and University of Pittsburgh, and his memberships in the American Society of Metals and Society of Lubrication Engineers will be of practical value to Mr. Chalfont in his Wyandotte service work. He will assist *Tom McHugh*, veteran Wyandotte man, who is well known in the South-

ern Ohio metal finishing industry.

Mr. McCarthy is a resident of Columbus and attended Ohio State University. For



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DETROIT (7) MICHIGAN

four years he was head of the Engineering Materials Laboratory of Curtiss-Wright Corporation and directed the activities of the chemical, metallurgical and physical sections. His previous experience plus his "refresher" training makes him well fitted for servicing Wyandotte Products in the metal finishing industry. He will operate under the direction of the Cleveland office of Wyandotte Chemicals where *Earle J. Esner* is the Industrial Department Representative.

•

Optimus Companies Housed in New Enlarged Plant

Optimus Equipment Company, engineers and manufacturers of metal washing and drying equipment, and *Optimus Detergents Company,* manufacturers of industrial cleaning materials, both of Matawan, N. J., are occupying their new enlarged plant, located there.

Since their inception two years ago, both companies have been located in the plant of the *Hanson-Van Winkle-Munning Company.* Recently, the buildings of the former Matawan Tile Company have been purchased for the purpose of providing the two Optimus activities with increased space and manufacturing facilities.

With the new plant in operation, improved streamlined production layouts for the manufacture of Optimus equipment, including a new line of metal degreasers, has been made possible. Operating with a considerable backlog of orders, the Optimus Equipment Company will now be enabled to speed up its production schedule.

The entire manufacturing facilities of Optimus Detergents will be housed in the new plant, a separate building being devoted to it. All told, the new plant consists of 11 buildings, 6 of which will be utilized by the Optimus activities, the balance will be occupied to a large extent by the parent organization, Hanson-Van Winkle-Munning Company.

All office, sales, laboratory, design and manufacturing personnel will be located at the new plant, which will be under the direction of *Allen T. Baldwin,* General Manager of the two Optimus companies.

New Plastic Rack Coating Announced by Peninsular

An odorless, non-inflammable plastic rack coating which can be applied in any plating plant without special precautions is announced by *Peninsular Chemical Products Company*, Van Dyke, Mich.

The coating material, known as *Pen-Kote 590*, consists of an aqueous dispersion of Saran plastic and contains no organic solvents. It is applied by hand dipping and dries in less than an hour at room temperature, giving complete protection in twenty-four hours. Because it is an aqueous dispersion rather than a solution, it is exceptionally free-flowing, draining rapidly without forming webs or strands to be trimmed off after dipping. The resulting rack coating is tough, flexible and highly resistant to all plating and cleaning solutions, including chlorinated degreasing solvents.

This new material and coating has seen months of service in plating plants of all types. Platers may send a sample rack to Peninsular Chemical Products Company to be given a free trial coating and returned for testing in their own plants.

•

Brown Developes Cut-out Switch for Critical Processes

Centrally located periodic temperature measurements for industrial processing have been made possible by introduction of new recorder cut-out switches which are especially adaptable to the petroleum and chemical industries.

The cut-out switch, developed by the *Brown Division* of *Minneapolis-Honeywell Regulator Company*, consists of a double-pole, double-throw mechanically operated push-button switch for multi-point indicators. The switch, according to *L. Morton Morley*, Vice-President and General Sales Manager of *Brown Instrument Company*, Philadelphia, provides cheaper and more practical installations for many critical applications. It does away, he said, with costly additional equipment.

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We have a very fair assortment of polishing and buffing lathes on hand, comprising—

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No great quantity of anything, but a good variety of horsepowers and speeds.

Tell us what you need and we probably are in a position to offer something which would meet your requirements.

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New York - - Philadelphia - - Woonsocket, R. I.

Mechanical Process Issues Pamphlet on Degreasers

An eight-page pamphlet published by *Mechanical Process Company*, South Orange, N. J., describes the *d'Oiler Degreasers*.

Among the features claimed are drain table for saving of solvent, full insulation for fuel economy, built-in exhaust duct for operators' safety, large clean-outs for easy cleaning, automatic feed for make-up solvent and replaceable cellular condenser. A number of different designs are illustrated and discussed.

•

United Chromium Issues 4-Page Folder on "Ucilon"

United Chromium, Inc., 51 E. 42nd Street, New York 17, N. Y., has issued a four-page descriptive folder on *Ucilon*. This folder gives properties, application data, and typical uses of this protective coating that resists severest corrosive conditions.

Developed from improved, inert, synthetic resins, this material is especially advantageous for maintenance work, and for products subjected to corrosive service.

Pennsalt Sets Up Packaging and Labeling Division

Rapidly expanding its activities in the field of chemical specialties and chemical products for consumers, the *Pennsylvania Salt Manufacturing Company* has established a new Packaging and Labeling Division, which began operations in December.

George W. Benbury, Packaging Engineer, has been appointed Manager of the new division. Mr. Benbury, who served in the U. S. Navy during the war, is an engineering graduate of North Carolina State College. He has been associated with Pennsalt since 1933.

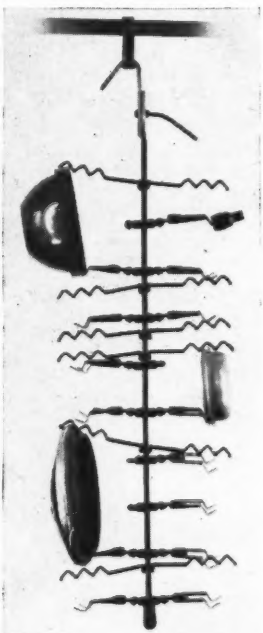
•

Pamphlet on Lead Anodes

A pamphlet, *Republic Homogeneous Lead Anodes*, for chromium plating may be obtained from *George L. Nankervis Company*, 5442 Second Boulevard, Detroit 2, Mich.

This anode is supplied with extra "throwing edges" and is reinforced at the solution level. A number of styles and sizes are described.

The Largest Exclusive Rack Manufacturers!



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Curtis Miller Appointed To United Chromium Post

Curtis G. Miller has been appointed Sales and Technical Representative for the Cleveland area by *United Chromium, Incorporated.*

Mr. Miller, who served as Technical Officer with the Army Chemical Services, was formerly connected with the *Chromium Corporation of America* and *The McGean Chemical Company.* His appointment brings a highly qualified technical adviser to the rapidly growing number of United Chromium customers in Cleveland and its surroundings.

Mr. Miller will now make available to this important area all of the Unichrome processes and materials, which include plating processes, materials for the plating plant, synthetic coatings for product finishing, and the latest developments in industrial protective coatings.

Booklet on Harshaw Modified XXX Bright Nickel Process

A booklet on *Harshaw Modified XXX Bright Nickel Process* is just off the press and is offered to all platers, especially those who are on the alert for information which will help maintain production at its peak.

Sixteen well-illustrated pages cover the products, formulae, economics and Harshaw services.

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Minneapolis-Honeywell Reveals Further Expansion Program

A further move in the *Minneapolis-Honeywell Regulator Company's* $4,000,000 expansion program has been disclosed with the announcement of the lease of a new building in Minneapolis.

The company has made arrangements to lease the two-story building formerly occupied by the Society for the Blind to house two rapidly expanding divisions. One floor will be devoted to class, lecture and demonstration rooms for the Honeywell sales school while the other floor will become headquarters for the research department.

A heating plant laboratory will be set up in the basement of the new building to be used largely by students of the school. The school is used to train new Honeywell sales and service engineers who are brought to Minneapolis in groups of about 30 for a 13-weeks' course in automatic controls and control principles. Staffed with its own instructors, the school is generally in session throughout the year.

•

H-VM-M Introduces New Grain and Cement Thinner

The *Hanson-Van Winkle-Munning Company* of Matawan, N. J., announces a new grain cement and thinner, a welcome addition to plating supplies in these days of glue shortages. This material is an improved adhesive for polishing wheels which overcomes the deficiencies of organic glues. It has been used in the field for a number of months with complete sucess.

Full and detailed directions are available on request to Hanson-Van Winkle-Munning Company at the above address.

•

Maas & Waldstein Products Available for Consumer Use

Two *Maas & Waldstein* products, well known in the industrial field—*No. 76 Spot Cement* and *No. 54 General Purpose Cement*—are being packaged for consumer use. It is expected that these fast drying, water-resistant cements will receive wide acceptance.

W. E. McCormick Appointed Industrial Hygiene Chief

William E. McCormick has been appointed Chief of the Industrial Hygiene Department of *The B. F. Goodrich Company*, it is announced by *Dr. Rex H. Wilson*, Medical Director.

Duties of McCormick's department will be to study operating conditions to see if they are hazardous, and if so, eliminate the hazards. He is now coordinating various toxicology studies made for the company in laboratories throughout the country, to determine what materials can be best used in certain products without toxic results to employees engaged in manufacture or the consumer.

McCormick comes to B. F. Goodrich from the State Health Department of Georgia, where he had been in industrial hygiene work. After receiving his Bachelor's and Master's Degrees at Pennsylvania State College, McCormick was in industrial hygiene with the Willson Company of Reading, Pa., from 1937 to 1943, when he joined the U. S. Public Health Service and also did work at the National Institute of Health in Bethseda, Md., and the Board of Health in North Carolina, before taking his post in Georgia.

•

H. P. Munger Superintendent for Youngstown Sheet and Tube

H. P. Munger, formerly Special Metallurgist at the Campbell plant of *The Youngstown Sheet and Tube Company*, is now Superintendent of the company's Tin Finishing Department at Indiana Harbor. Munger, a graduate of Georgia Tech, joined Youngstown June 27, 1945.

Mr. Munger was an Industrial Fellow at Mellon Institute in Pittsburgh for two years; Metallurgist, Research Laboratory of The American Rolling Mills Company, in Middletown, Ohio, for seven years; Assistant Chief Metallurgist and Superintendent of electrotin plating for Republic Steel Corporation for two years; Plant Manager for Van der Horst Corporation at Olean, N. Y., for two years and Metallurgist for The Youngstown Sheet and Tube Company at Youngstown for one year. He is active in A. E. S. and A. S. T. M.

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PROGRESSIVELY BETTER ABRASIVE COMPOUNDS

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1—5000/2500 AMPERE, 6/12 VOLT, **CHARLES J. BOGUE ELECTRIC COMPANY,** Interpole Design—Separately Excited.
1—4000/2000 AMPERE, 6/12 VOLT, **HANSON & VAN WINKLE COMPANY,** Compound Wound—Separately Excited.
1—2500/1250 AMPERE, 6/12 VOLT, **HANSON & VAN WINKLE COMPANY**—Shunt Wound, Separately Excited.
1—2000/1000 AMPERE, 10/20 VOLT, **CHANDEYSSON ELECTRIC COMPANY**—25° Unit, with Synchronous Motor Drive.
1—2000/1000 AMPERE, 10/20 VOLT, **COLUMBIA ELECTRIC COMPANY**—25° Unit, with Synchronous Motor Drive.
1—2000/1000 AMPERE, 6/12 VOLT, **HANSON-MUNNING**—40° Unit—with Synchronous Motor Drive.
2—1500/750 AMPERE, 6/12 VOLT, **ELECTRIC PRODUCTS COMPANY**—Separately Excited—Ball-bearing Design.
1—1500 AMPERE, 40 VOLT, **HANSON-VAN WINKLE-MUNNING COMPANY**—Practically New—Synchronous Motor Drive—for ANODIZING—with Automatic Controls.
3—1000/500 AMPERE, 6/12 VOLT, **CHARLES J. BOGUE ELECTRIC COMPANY**—Practically New—Separately Excited.
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SMALLER UNITS FROM 50 AMPERES UP, CARRIED IN STOCK AT ALL TIMES FOR IMMEDIATE SHIPMENT.

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ANODIZING MOTOR GENERATOR SETS—in Stock for Sulphuric or Chromic Acid Solutions. Large selection. Write for details.

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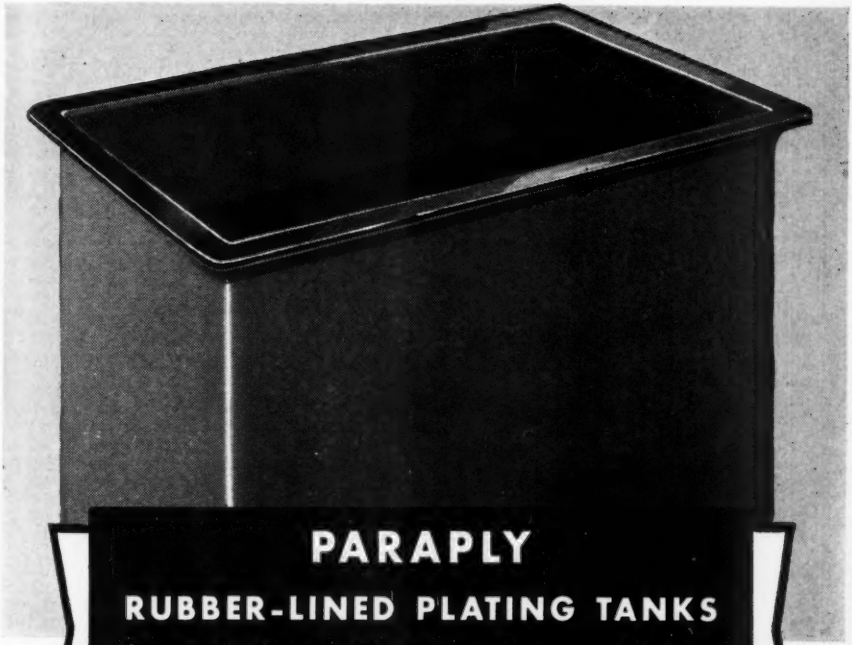

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Frankly, we never are, until we're absolutely sure that each "U. S." Paraply rubber-lined tank will do an even better job than our customer expects.

Of the hundreds of Paraply rubber-lined plating tanks we have installed during the last few years, just two have failed to measure up to this standard of service.

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BALTIMORE-WASHINGTON meets first Tuesday of each month in October, December, February and April in Baltimore, Md., and in November, January, March and May in Washington, D. C. Secretary, Grace Riddell, Chemistry Division, National Bureau of Standards, Washington 25, D. C.

BOSTON meets first Thursday of each month in Hotel Statler, Boston, Mass. Secretary, Dr. George P. Swift, 53 Galen Street, Watertown 72, Mass.

BRIDGEPORT meets first and third Friday of each month in Barnum Hotel. Secretary-Treasurer, Joseph G. Sterling, 134 Colony Street, Bridgeport 8, Conn.

BUFFALO meets second Friday of each month in Hotel Statler, Buffalo, N. Y. Secretary, J. Ruff, 473 Breckenridge St., Buffalo 13, N. Y.

CHICAGO meets second Friday of each month at 8 P. M., in Atlantic Hotel. Secretary, M. H. Longfield, 1528 S. 61st Avenue, Cicero 50, Ill.

CINCINNATI meets on fourth Wednesday of each month at 8 P. M., in Engineering Society Headquarters, McMillan Street and Woodburn Avenue, Cincinnati Ohio. Secretary-Treasurer, Charles Nuzum, 1240 Amanda Place, Cincinnati 5, Ohio.

CLEVELAND meets first Friday of each month in Cleveland Hotel, at 8 P. M. Secretary-Treasurer, George B. Svenson, 2059 Hamilton Avenue, Cleveland 14, Ohio.

COLUMBUS meets first Friday of each month in Battelle Memorial Institute Auditorium, 505 King Avenue, Columbus 1, Ohio, at 8 P. M. Secretary, John G. Beach, Battelle Memorial Institute, Columbus 1, Ohio.

DAYTON meets second Friday of each month in Engineers' Club, Dayton, Ohio. Secretary-Treasurer, Ralph L. Clinefelter, 365 W. Hayes Street, West Milton, Ohio.

DETROIT meets first Friday of each month in Hotel Statler. Secretary-Treasurer, F. L. Clifton, 16536 Inverness, Detroit 21, Mich.

GRAND RAPIDS meets second Friday of each month, 7:30 P. M., in Rowe Hotel. Secretary, R. Perkins, 916 Fairmount Street, S. E., Grand Rapids 6, Mich.

HARTFORD meets third Monday of each month in Hotel Bond, Hartford, Conn. Secretary, F. W. Smith, 46 Cottage Street, Meriden, Conn.

INDIANAPOLIS meets first Wednesday of each month at Fox Steak House, 1207 Washington Street. Secretary-Treasurer, Carl Niehaus, 937 N. Capitol Avenue, Indianapolis, Ind.

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LOS ANGELES meets second Monday of each month, at 6:30 P. M., in Hotel Cabrillo, 11th and Broadway. Secretary-Treasurer, E. R. Holman, P. O. Box 2649, Terminal Annex, Los Angeles 54, Calif.

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NEWARK meets first and third Friday of each month in Hotel Robert Treat, Newark, N. J., at 8 P. M. Secretary-Treasurer, George Wagner, 1130 S. Long Avenue, Hillside, N. J.

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TOLEDO meets first Thursday of each month in the office of Vic Miner Company, 329 20th Street, Toledo, Ohio. Secretary, Gaston Bergeman, 703 Pine Street, Fremont, Ohio.

TORONTO meets second Friday of each month in Royal York Hotel. Secretary, Leonard W. Wray, 105 Ronan Avenue, Toronto 12, Ont., Canada.†

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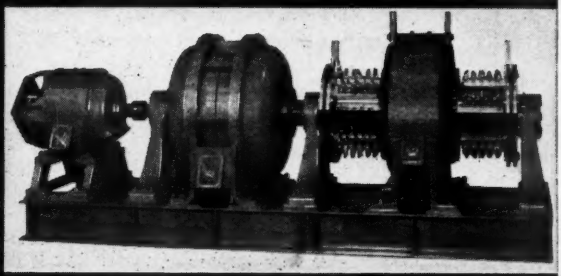

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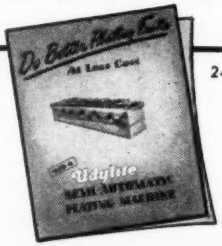

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INDEX TO ADVERTISERS

A

Alsop Engineering Corp. 132
American Buff Company. 118
American Chemical Paint Co. 154
American Electroplaters' Society. 169, 226

B

Baker Company, M. E. 236
Blakeslee & Co., G. S. 242

C

Ceilcote Company, The 234
Chemical Corporation, The 136
Columbia Electric Mfg. Co. 239
Cowles Detergent Company. 124
Crane Equipment & Supply Co. 242

D

Divine Brothers 228

E

Egyptian Lacquer Mfg. Co. 134

G

General Chemical Co. 221
General Electric Co. 133
Gumm Chemical Co., Frederick. ..... Second Cover

H

Hammond Machinery Builders, Inc. 230
Hanson-Van Winkle-Munning Company. 178-179
Harrison & Company 235
Harshaw Chemical Co., The 119
Hay Company, Jacob 236

I

Industrial Filter & Pump Co. 128

K

Kirk & Blum Mfg. Co. 228
Kocour Company. 229

L

Lasalco, Inc. 127
Lea Mfg. Company ..... Back Cover
L'Hommedieu & Sons Co. 121

M

Maas & Waldstein Co. 172
MacDermid, Inc. ..... Third Cover
Magnuson Products Corp. 234
McGean Chemical Co., The. 122
Meaker Company, The 120
Michigan Buff Company. 230
Miller, J. C. Company 125
Munning & Munning, Inc. 231

N

Nelson Chemicals Corporation ... 115

O

Oakite Products, Inc. 170
Optimus Equipment Company. ... 123

P

Pennsylvania Salt Mfg. Co. 129
Promat Div., Poor & Co. 217
Puritan Mfg. Co., The 130

S

Seeley Company, E. E. 236
Standard Plating Rack Co. 232
Stevens Co., Frederic B. 116
Storts Welding Company 208
Sulphur Products Co. 233

U

Udylite Corporation 240
United Chromium, Inc. 126
U. S. Government .....
U. S. Stoneware Co. 237

W

Wyandotte Chemical Corp. 131

Z

Zapon Div., Atlas Powder Co. 139

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